

## **APPENDIX 2C-2**

### **July 2005 Consolidated Pre-Meeting Comments**

#### **Peer Review of Proposed Water and Other Relevant Indicators for EPA's 2006 Report on the Environment**

July 19, 2005

**Notice:**

Pre-meeting comments were prepared by each consultant individually prior to the meeting. They are preliminary comments only, and are used to help consultants become familiar with the document and charge questions, develop the agenda, and identify key issues for discussion. During the meeting, consultants may expand on or change opinions expressed in their pre-meeting remarks and may introduce additional issues. For these reasons, pre-meeting comments should be regarded as preliminary and do not reflect the final conclusions and recommendations of individual consultants. These pre-meeting comments will be included as an appendix in the meeting summary report, along with other background materials.

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# Water Reviewer Biographies

## **William Creal**

Michigan Department of Environmental Quality  
Permits Section

I have been an Environmental Manager in Michigan for the past 17 years with extensive experience in almost all phases in the Water Program. Prior to that, I was an Aquatic Biologist with extensive experience in surface water monitoring and applying the results to Water Quality Standards, NPDES permits, and sediment remediation projects. In my 27 years experience, I have seen the water programs develop and mature, and witnessed the substantial progress that has been made in cleaning up our waters. I have provided some additional specifics below:

2003-2005      Chief, Permits Section, Water Bureau  
Michigan Department of Environmental Quality

Responsible for all activities associated with the NPDES and Groundwater point source discharge permits for the state of Michigan. These activities include permit issuance, development and application of both technology and water quality based effluent limits and antidegradation requirements, and the development and maintenance of the computer database and applications for the permit management system.

1988-2003      Chief, Water Quality Appraisal Unit  
Great Lakes and Environmental Assessment Section  
Michigan Department of Environmental Quality

Responsible for development and implementation of Michigan Water Quality Standards, including water quality based NPDES permit limits, the surface water monitoring program, Michigan's biennial report on Water Quality, development of the list of water bodies needing Total Maximum Daily Loads (TMDLs) and the development of TMDLs, and sediment remediation projects and Natural Resource Damage Assessments for Michigan. The surface water monitoring program included sampling and reporting on results from water, sediment, fish tissue, aquatic life (primarily fish and macroinvertebrates), and microorganisms. This included development of Michigan's comprehensive surface water monitoring strategy in 1997.

1978-1988      Aquatic Biologist, Water Quality Appraisal Unit  
Great Lakes and Environmental Assessment Section  
Michigan Department of Natural Resources

**Anitra Pawley**

University of California and The Bay Institute

Dr. Anitra Pawley, Senior Ecologist at the Bay Institute joined the group in 1997, after completing her Ph.D. at the University of California, Davis with an emphasis on aquatic ecology. Since that time, she has focused on developing a research program dedicated to indicator development at the Bay Institute with ties to other regional research and monitoring programs. The first phase of her work on indicators focused on helping the California Bay Delta Program Authority Ecosystem Restoration Program identify appropriate indicators of program performance. She also participated in the Agency Stakeholder Ecosystem Team, a consortium of scientists who serve as technical advisors to the Ecosystem Restoration Program and the Wetland Resource Monitoring Program. Her recent projects, include the development of regional level indicators (The Bay Delta Ecological Scorecard) and the use of archival data to evaluate wetland health (Pacific Estuarine Ecological Research Program). She has developed reviews of wetland and benthic indicators. Currently, she has a dual appointment with the University of California, Davis where she is the principal researcher on a Coastal Watershed Assessment project for the National Park Service.

Prior to the work she now pursues, she coordinated the development of several statewide resource inventories/databases at the Information Center for the Environment, U.C. Davis to provide a technical tool for the assessment of restoration activities. Her experience in aquatic ecology, remote sensing and geographic information systems included research on streams, lakes and wetland ecosystems in a variety of Western Hemisphere habitats. Dr. Pawley also worked with the Tahoe Regional Planning Agency to develop their first environmental education and public outreach program.

**Hans Paerl**

University of North Carolina at Chapel Hill  
Institute of Marine Sciences

Hans W. Paerl is Kenan Professor of Marine and Environmental Sciences, at the UNC-Chapel Hill Institute of Marine Sciences. He has designed and directed numerous water quality and environmental research programs in North Carolina, nationally and internationally, including: the Neuse River Estuary Modeling and Monitoring Program (ModMon; [www.marine.unc.edu/neuse/modmon](http://www.marine.unc.edu/neuse/modmon)), the Ferry-Based Water Quality Monitoring Program for the Pamlico Sound System, FerryMon ([www.ferrymon.org](http://www.ferrymon.org)), and the EPA-STAR supported Atlantic Coastal Environmental Indicator Consortium, ACE INC ([www.aceinc.org](http://www.aceinc.org)). His research includes; nutrient cycling and production dynamics of aquatic ecosystems, environmental controls of algal production (including algal blooms), and developing and testing broadly-applicable, integrative indicators of ecological condition, integrity, and sustainability in estuarine and coastal ecosystems. His work has focused on assessing the causes and consequences of eutrophication. Recent studies have included identifying the importance and ecological impacts of atmospheric nitrogen deposition in estuarine and coastal environments and the development of bio-indicators used to assess human- and climate-induced change in aquatic ecosystems. He was recently (Feb., 2003) presented with the G. Evelyn Hutchinson research achievement award by the American Society of Limnology and Oceanography for “contributing to the understanding of aquatic microbial processes, for documenting linkages among the atmospheric deposition of nitrogen, coastal eutrophication, and harmful algal blooms, and for crossing traditional research boundaries to system-level perspectives within freshwater, estuarine and marine ecosystems”. His work plays a central role in identifying, managing and reversing declines in coastal water quality and fisheries habitat facing North Carolina and the nation.

**N. Scott Urquhart**

Department of Statistics

Colorado State University

N. Scott Urquhart directs the Space-Time Aquatic Resources Modeling and Analysis Program (STARMAP), funded by an EPA cooperative agreement, in the Department of Statistics of Colorado State University (CSU), Fort Collins, CO. He has served as a statistical collaborator for over 45 years on a wide range of projects in agriculture, the environment, and natural resources. He has been involved with both quality and quantity of water since he moved from Cornell University to the arid context of New Mexico State University in 1970. After retiring there in 1991, he collaborated closely with EPA's Environmental Monitoring and Assessment Program (EMAP) from the Department of Statistics at Oregon State University, Corvallis, OR. Since 2000 he has directed STARMAP from CSU. He is quite familiar with EMAP, The national Wetlands Inventory's (NWI) Status and Trends Program, and fairly is familiar with the National Resources Inventory (NRI) and some features of water quality programs of the United States Geologic Service (USGS), as well as a number of other national and regional natural resource surveys. He has served in numerous professional capacities in statistics, has coauthored a book, more than 60 refereed journal articles, and more than 100 other pieces of professional writing.

## **Comments for Group 1 Indicators**

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## Attachment 2: Comment Sheet for Group 1 Indicators

Topic Area: **Water**  
Indicator Name: **Lake and Stream Acidity**

- 1) Please indicate the extent to which you think the proposed indicator is appropriate, adequate, and useful (AA&U) for evaluating our nation's waters and for contributing to an overall picture of our nation's waters.

1	2	3	4
Indicator is not AA&U	Indicator is of somewhat AA&U	Indicator is largely AA&U	Indicator is completely AA&U

Creal: (3) This indicator raises the question of what is a national indicator. This indicator is focused on five regions in the Northeastern United States, yet proclaimed to be a national indicator. Presumably because this represents the most sensitive regions to acid deposition. As was indicated on a conference call, a national indicator is one with a dataset in an area where the issue exists. I agree with this approach, and would urge consideration of more indicators of this "national" type, such as a suite of Great Lakes indicators.

Paerl: (3) This indicator is broadly useful, but perhaps should be expanded to regions undergoing rapid urbanization, industrial and agricultural development/expansion. This would include the US Southeast and possibly the Southwest. The Southeast has many freshwater systems, including lakes, stream and rivers that can be classified as "soft water", i.e. low in alkalinity and buffering capacity, and hence may be sensitive to acidification. At present, it is difficult to assess to what extent these waters are being impacted by acidity from atmospheric deposition and discharge/runoff sources.

Pawley: (3) This is an appropriate indicator, one that should be updated on a regular basis, perhaps every five years. However, it is not adequate in its current form, as it excludes a large portion of the U.S. Though west coast lakes are not depicting chronic acid problems like those on the east coast, it is important to monitor and report on changes over time across the nation. For example, research has shown high levels of acid rain and acid fog in Southern California, and the presence of episodic acid events in Sierra West coast lakes (Leydecker et.al. 1999). There is also some concern that global warming will exacerbate this problem resulting in an increase in the number of thunderstorms (often acidic) relative to snowstorms in the Sierra Nevada Mountains in the West.

If at all possible, the indicator as presented should include more recent information and a more continuous record so that a trend can be ascertained.

Urquhart: (4) This indicator is critical, given the Clean Air Act Amendments of 1990. EPA has been actively gathering data for it since 1991.

- 2) Please indicate the extent to which you think the proposed indicator makes an important contribution to answering the specific ROE question it is intended to answer (see Attachment 1 for list of questions). (Note: An indicator may be judged less important if it makes a smaller or less critical contribution to answering the question posed than the other indicators, or if it covers an area of less or diminishing importance environmentally.)

1	2	3	4
Indicator is not important	Indicator is of minor importance	Indicator is important	Indicator is critical

Creal: (4) This indicator has a strong relationship with the controls implemented in the Clean Air program. This is a good response indicator. There should be some link, perhaps by cross referencing or putting an indicator in two places, with the Air indicator regarding Acid Deposition. Other indicators of this nature should be identified and used, such as the response in the environment to reduced lead in a variety of products like gasoline and paint.

Paerl: (3)

Pawley: (3) This indicator is important; however, it only answers one aspect of this question. It does not provide an overview of condition, but rather whether the surface water is acidic or not. There are many other important aspects of lake condition that should be addressed, such as nutrient levels, turbidity from excess sediment, reduction in clarity, and toxic compound inputs. In particular, increased nitrogen levels are a direct result of acid rain – Nitrous oxide emissions. Despite our not being able to receive the additional proposed indicators in this category, I hope that EPA will continue its push to create these.

Urquhart: (4) Directly addresses trends in extent and condition of Ambient Fresh Surface Waters Lake and Stream Acidity.

- 3) To what extent do you think the indicator meets the following indicator definition:

*An “indicator” is a numerical value derived from actual measurements of a pressure, ambient condition, exposure, or human health or ecological condition over a specified geographic domain, whose trends over time represent or draw attention to underlying trends in the condition of the environment.*

1	2	3	4
Doesn't meet the definition	Only partly meets the definition	Largely meets the definition	Fully meets the definition

Creal: (4) This indicator is an actual measurement that corresponds directly with the deposition of acid rain, and covers the sensitive areas in the United States.

Paerl: (3) Acidity is an indirect, but nevertheless useful, indicator of pressure and ecological condition. The relationship(s) between acidity, ecological condition and habitability of relevant ecosystems and habitats are often non-linear, involve lags and are dependent on nutrient status and climatic condition (and change).

Pawley: (2/3) I think it only partly meets the definition because only two years of data are represented; though it could be fashioned to meet the criteria.

Urquhart: (4) It directly measures an ambient condition which can also be a pressure on ecological condition of lakes and streams. This indicator has been evaluated over the entire domain for which it is a concern. It has not been evaluated in parts of the country where soil alkalinity will immediately neutralize acid rain.

4) To what extent do you think the indicator meets each of the following indicator criteria:

- a) The indicator makes an important contribution to answering a question for the ROE. (In this context, “important” means that the indicator answers a substantial portion of and/or a critical part of the question.)

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (4)

Paerl: (3)

Pawley: (3)

Urquhart: (4)

- b) The indicator is objective. It is developed and presented in an accurate, clear, complete, and unbiased manner.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (3)

Paerl: (4)

Pawley: (3)

Urquhart: (4)

- c) The underlying data are characterized by sound collection methodologies, data management systems that protect its integrity, and quality assurance procedures.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (4)

Paerl: (4)

Pawley: (4)

Urquhart: (4)

d) Data are available to describe changes or trends, and the latest available data are timely.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (4)

Paerl: (2) This largely depends on the length and spatial extent of data base.

Pawley: (2)

Urquhart: (3)

e) The data are comparable across time and space, and representative<sup>1</sup> of the target population. Trends depicted in this indicator accurately represent the underlying trends in the target population.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (3)

Paerl: (3)

Pawley: (2)

Urquhart: (4)

f) The indicator is transparent and reproducible. The specific data used and the specific assumptions, analytic methods, and statistical procedures employed are clearly stated.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (4)

Paerl: (4)

Pawley: (2)

Urquhart: (4)

Please explain:

Creal: This indicator helps answer the question, and has timely data used to represent the indicator.

Paerl: [no answer provided]

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<sup>1</sup> An indicator seeks to describe trends in an overall target "population" (e.g., land area, type of surface water, type of emissions, U.S. population), yet data often can only be sampled from a subset of this population. The validity of the trends described by the indicator will depend on the degree to which the sampled population is representative of the target population.

Pawley: The indicator didn't meet the criteria based on time and space because of the limited geographic coverage and the limited number of years presented. This is an important indicator that should be expanded in scope if feasible, so that it meets the criteria more fully. Funds should be made to ensure that more west coast resources are represented.

Also, my response to f above is a result of the fact that the units used for this indicator confuse me. ANC is declining in the graph, as it stands for Acid Neutralizing Capacity ; however, the text refers to different units (200 and 50  $\mu\text{eq/L}$ ) and the fact that higher values are indicators of more ANC and better conditions.

Finally, this like all indicators has a conceptual model as a basis for it, but under T1Q3, it is considered not applicable, which I find confusing.

Urquhart: The data for Northeastern Lakes and Mid-Atlantic streams is quite timely, given the delays between field visits, quality assurance work and reporting. The data on the Upper Mid-West is rather out of data. The principal report does a creditable job of updating an old (1980s) survey, but it has to extrapolate current state from non-probability sites.

5) Do you have any suggestions for more effective graphic presentation of the data?  
If yes, please describe.

Creal: Yes. For this indicator, the whole country should be described as data are available, at least in a spatial context so the readers can readily understand why the regions selected for temporal trends are acid sensitive.

Paerl: [no answer provided]

Pawley: Label the year "current" with appropriate year. Include a legend that defines ANC on the graphic presentation and explain the units and their meaning.

Urquhart: The graphic presentation, even after the correction we received, badly misrepresents the parent report. As other reviewers may not have immediate access to the parent report, I (nsu) include a critical paragraph here:

Upper Midwest Lakes: The TIME project has not operated in the Upper Midwest, so the best population estimates for this region come from the 1984 Eastern Lake Survey (Linthurst et al. 1986b). ELS sampling in the Upper Midwest estimated that 251 lakes, or 2.9% of the population, were acidic in 1984 (Baker et al. 1991). LTM data suggest a rate of change of +1  $\mu\text{eq/L/year}$  in this region (Table 5); extrapolated to the present, this represents an increase of +18  $\mu\text{eq/L}$  of Gran ANC in sensitive lakes between 1984 and 2002. In 1984, 80 lakes had Gran ANC values less than -18  $\mu\text{eq/L}$ , and all of these are now estimated to be non-acidic. This represents a change from 2.9% acidic in 1984, to 0.9% in 2002, an overall reduction in the number of acidic lakes of 68%.

Stoddard, J.L., Kahl, J.S., Deviney, F.A., DeWalle, D.R., Driscoll, C.T., Herlihy, A.T., Kellogg, J.H., Murdoch, J.R. Webb, J.R., and Webster, K.E. (2003). Response of Surface Water

Chemistry to the Clean Air Act Amendments of 1990. EPA/620/R-02/004. US Environmental Protection Agency, Washington, DC.

<http://www.epa.gov/ord/htm/CAAA-2002-report-2col-rev-4.pdf>

The essential point is that this original report refers to change across two decades, but the draft report tries to shove the results into one decade.

- 6) Please provide any additional comments, suggestions, or concerns regarding the indicator that you have not already noted in Questions 1 through 5. In particular, note any limitations to the indicator that you have not already described in your responses to the preceding questions.

Creal: [no answer provided]

Paerl: [no answer provided]

Pawley: Limitations are covered above and include the limited geographic scope of the ANC measurements and the omission of some other very important parameters that affect inland aquatic ecosystems, particularly lakes. One concept might be to include measures of trends in clarity, nutrients, and turbidity in large lakes across the U.S. as an indication of overall trends. For example, there is a long record of changing clarity, and changing nutrients and chlorophyll in Lake Tahoe, CA that is frequently cited (See Goldman et. al. and Jassby et. al. refs) and this type of measure could be mirrored in other areas and aggregated for a sampling of surface water conditions.

Urquhart: The main question refers to lakes AND streams, as does the parent report does, too. However, the draft report text almost ignores streams. This should be corrected.

**TO FELLOW REVIEWERS:** If you look up the above citation on the web, the relevant material occurs primarily on pages 51 – 66.

7) Overall, this indicator:

Creal: ☒ Should be included in ROE06 TD.

Paerl: ☒ Should be included in ROE06 TD.

Pawley: ☒ Should be included in ROE06 TD.

☒ Should be included in ROE06 TD with the modifications identified above.

Urquhart: XXX\_ Should be included in ROE06 TD.

## Attachment 2: Comment Sheet for Group 1 Indicators

Topic Area: **Water**  
Indicator Name: **Nitrate, Phosphorus and Pesticides in Streams in Agricultural Watersheds**

- 1) Please indicate the extent to which you think the proposed indicator is appropriate, adequate, and useful (AA&U) for evaluating our nation's waters and for contributing to an overall picture of our nation's waters.

1	2	3	4
Indicator is not AA&U	Indicator is of somewhat AA&U	Indicator is largely AA&U	Indicator is completely AA&U

Creal: (1) This indicator is not adequate or useful in making a contribution. Although this is useful information for either groundwater or drinking water (where there are drinking water intakes on surface water streams), this indicator does not address the question regarding the trends in extent and condition of fresh surface waters in the United States. The data used is not representative of current conditions in the streams sampled, as this condition changes very rapidly in these water bodies. The use of a mean condition to represent each stream for each parameter does not take into account the exposure period for each parameter, like the drinking water nitrate endpoint used.

Paerl: (3) Essential and useful indicator, but at present only available for targeted watersheds. Mainly applicable to major river basins. Data are not available for smaller watersheds and hence "may not be an accurate reflection of the distribution of concentrations in all streams in agricultural watersheds in the US).

Pawley: (3) The proposed indicator is entirely appropriate as nutrient contamination is a widespread problem in agricultural watersheds; however, it is important to look for sources of data for other types of water bodies, such as lakes. It is also important to consider changes in nutrient levels in non-agricultural watersheds.

Urquhart: (2) Criterion above "... contributing to an overall picture ..." This indicator reflects only Agriculture Lands. What about urban, forested, mountains, or desert?

- 2) Please indicate the extent to which you think the proposed indicator makes an important contribution to answering the specific ROE question it is intended to answer (see Attachment 1 for list of questions). (Note: An indicator may be judged less important if it makes a smaller or less critical contribution to answering the question posed than the other indicators, or if it covers an area of less or diminishing importance environmentally.)

1  
Indicator is not  
important

2  
Indicator is of  
minor importance

3  
Indicator is  
important

4  
Indicator is  
critical

Creal: (1) See previous comment. In addition, this indicator is misleading, given the rapid change in water quality that occurs in streams.

Paerl: (3) See comments above

Pawley: (4) The proposed indicator is critical, but again a more specific assessment question is warranted and as the following comments indicate, I think this indicator needs more work (see below).

Urquhart: (2) Not a national indicator.

3) To what extent do you think the indicator meets the following indicator definition:

*An “indicator” is a numerical value derived from actual measurements of a pressure, ambient condition, exposure, or human health or ecological condition over a specified geographic domain, whose trends over time represent or draw attention to underlying trends in the condition of the environment.*

1  
Doesn't meet  
the definition

2  
Only partly  
meets the definition

3  
Largely meets  
the definition

4  
Fully meets  
the definition

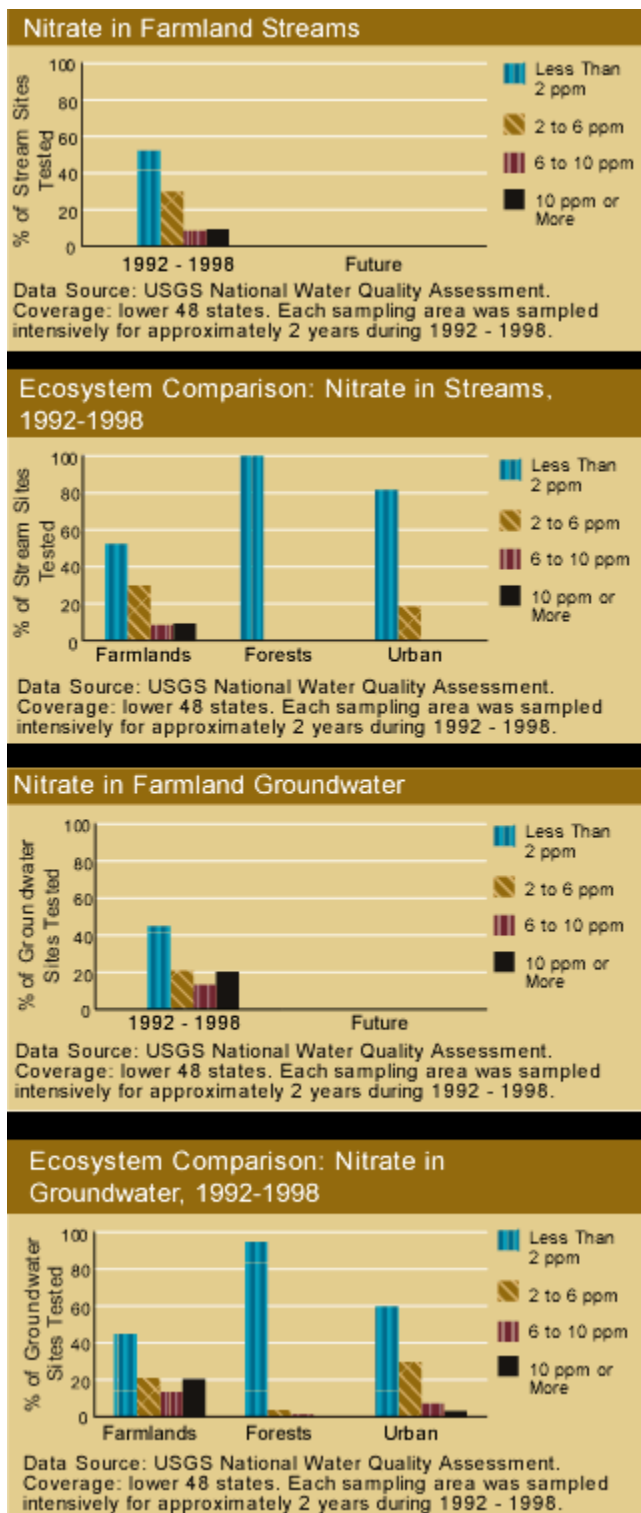
Creal: (2) This indicator does not function well with streams and the endpoints chosen. Streams are highly variable in their flow and concentration characteristics. The information provided is now not timely, and also does not portray any trends.

Paerl: (3) This indicator reflects key pressures (N, P pesticide loads, concentrations) that impact ambient conditions. Good linkage to habitat effects and condition, but no clear linkage to human health effects.

Pawley: (2) The indicator as it is presented only partly addresses this definition because it averages trends over the entire period. It appears that this was done out of necessity because of NAWQA's sampling design; however, the indicator should show information on an annual basis or perhaps using 2-3 year averages to provide trends.

Perhaps, a more interesting portrayal of this information would be a comparison of these values in agricultural watersheds with those watersheds without agriculture. The background information indicates that additional data from NAWQA is available and when I looked at the Heinz Center website, I found that indeed this comparison was made. See figure below





**Figure 1: Nitrate in Surface and Groundwater Comparison**  
Source: Heinz Center (<http://www.heinzctr.org/news.htm>)

Urquhart: (4) Measures an ambient condition

4) To what extent do you think the indicator meets each of the following indicator criteria:

- a) The indicator makes an important contribution to answering a question for the ROE. (In this context, “important” means that the indicator answers a substantial portion of and/or a critical part of the question.)

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (1)  
Paerl: (3)  
Pawley: (3)  
Urquhart: (2)

- b) The indicator is objective. It is developed and presented in an accurate, clear, complete, and unbiased manner.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (2)  
Paerl: (2/3)  
Pawley: (3)  
Urquhart: (2)

- c) The underlying data are characterized by sound collection methodologies, data management systems that protect its integrity, and quality assurance procedures.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (3)  
Paerl: (3)  
Pawley: (4)  
Urquhart: (4)

- d) Data are available to describe changes or trends, and the latest available data are timely.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (1)  
Paerl: (3)  
Pawley: (1)  
Urquhart: (4)

- e) The data are comparable across time and space, and representative<sup>2</sup> of the target population. Trends depicted in this indicator accurately represent the underlying trends in the target population.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (2)  
Paerl: (2/3)  
Pawley: (2)  
Urquhart: (1)

- f) The indicator is transparent and reproducible. The specific data used and the specific assumptions, analytic methods, and statistical procedures employed are clearly stated.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (3)  
Paerl: (3)  
Pawley: (3)  
Urquhart: (4)

Please explain:

Creal: This indicator does not address the question regarding the trends in extent and condition of fresh surface waters in the United States. The data used is not representative of current conditions in the streams sampled, as this condition changes very rapidly in these water bodies. The use of a mean condition to represent each stream for each parameter does not take into account the exposure period for each parameter, like the drinking water nitrate endpoint used.

Paerl: [no answer provided]

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<sup>2</sup> An indicator seeks to describe trends in an overall target “population” (e.g., land area, type of surface water, type of emissions, U.S. population), yet data often can only be sampled from a subset of this population. The validity of the trends described by the indicator will depend on the degree to which the sampled population is representative of the target population.

Pawley: The indicators are objective, but they could more fully meet the criteria if calculated and presented in a more complete and informative fashion. My comments focus on providing more details on the regional distribution of condition and trends and on alternative means of calculating an index from the data.

***Regional differences:*** For all indicators, nitrate, phosphorus and pesticides, data should also be shown in a more disaggregated form to better depict condition and trends regionally. In addition, this would enable the analysis to include reference conditions based on EPA aggregate regional nutrient criteria. For example, on the west coast, a pristine reference condition might be as low as 0.12; however, this might be below the limit of detection.

***Alternative index methodology:*** An alternative method (see CME method, (add ref) Pawley and Swanson (2004) would enable one to present the scope, magnitude and frequency of occurrences by year. The sampling regime might pose a problem; however, sub-samples of the data might help address this potential problem. Also, this technique is more compatible with the pesticides portion of the indicator as there are more constituents measured.

Urquhart: Target population is undefined. It does not meet the condition of a national indicator, as it omits substantial parts of the country and land use types.

5) Do you have any suggestions for more effective graphic presentation of the data?  
If yes, please describe.

Creal: No.

Paerl: Once more information is available on local watersheds and individual streams, appropriate tabular and graphical presentations can be made.

Pawley: Nitrogen and Phosphorus: Disaggregate information by years and region (see comment above). Include a comparison with non-agricultural areas. Place information regarding the reference standards in the legends. Incorporate key findings through bulleted lists.

Pesticides – use a more robust aggregation procedure such as the CCME method, show ratings for scope, frequency and magnitude.

Urquhart: If this indicator is included, a map showing its biased coverage and a discussion of the magnitude of this bias is essential.

6) Please provide any additional comments, suggestions, or concerns regarding the indicator that you have not already noted in Questions 1 through 5. In particular, note any limitations to the indicator that you have not already described in your responses to the preceding questions.

Creal: [no answer provided]

Paerl: [no answer provided]

Pawley: Add CCME method description here.

Urquhart: This indicator implicates agricultural watersheds by their inclusion, but what about urban, grassland, national park, or military reservations?

7) Overall, this indicator:

Creal: \_\_X\_\_ Should *not* be included in ROE06 TD.

Paerl: \_\_X\_\_ Should be included in ROE06 TD with the modifications identified above.

Pawley: \_\_X\_\_ Should be included in ROE06 TD with the modifications identified above.

Urquhart: \_XXXX\_ Should *not* be included in ROE06 TD.

## Attachment 2: Comment Sheet for Group 1 Indicators

Topic Area: **Water**

Indicator Name: **Nitrogen and Phosphorus Discharges from Large Rivers**

- 1) Please indicate the extent to which you think the proposed indicator is appropriate, adequate, and useful (AA&U) for evaluating our nation's waters and for contributing to an overall picture of our nation's waters.

1

Indicator is not  
AA&U

2

Indicator is of  
somewhat AA&U

3

Indicator is  
largely AA&U

4

Indicator is  
completely  
AA&U

Creal: (3) This indicator provides a good contribution of information on our nation's waters.

Paerl: (3) Useful and essential indicator, but focus for N should go beyond nitrate, and include ammonium and total N (as well as total P). In many watersheds (especially those supporting CAFOs and other animal operations) ammonium and organic N are becoming more important sources of biologically-available "new" N. These should be included in the N load inventory. Also, in some receiving waters (both freshwater and marine) N *and* P co-limitation of productivity, and hence eutrophication potential, exists. While limitation tends to be more prevalent in freshwater and N limitation tends to characterize marine systems, co-limitation can exist in these systems. This should be recognized, as nutrient management strategies aimed at reducing eutrophication potentials in both system types will need to consider and address *both* N and reductions.

Pawley: (2) The indicator is important as excessive amounts of Nitrogen and Phosphorus in water bodies due to anthropogenic disturbance is a widespread problem. The four rivers assessed are important contributors to this problem, nation-wide (representing 55% of annual stream flow); however, the data should be augmented to the extent possible with that from other sources. For example, the San Joaquin and Sacramento Rivers in California are the subjects of USGS NAWQA studies and could be accessed.

Urquhart: (4) These indicators relate to a substantial part of the country, without land use bias. They reflect an important stressor for coastal systems, especially the Gulf of Mexico.

- 2) Please indicate the extent to which you think the proposed indicator makes an important contribution to answering the specific ROE question it is intended to answer (see Attachment 1 for list of questions). (Note: An indicator may be judged less important if it makes a smaller or less critical contribution to answering the question posed than the other indicators, or if it covers an area of less or diminishing importance environmentally.)

1	2	3	4
Indicator is not important	Indicator is of minor importance	Indicator is important	Indicator is critical

Creal: (3) This indicator is important in that it covers a substantial portion of the watershed of the 48 states, and provides information on two important nutrients in surface waters

Paerl: (3) See comments above

Pawley: (3) This is an important measure of water quality condition, but additional data is needed from other systems.

Urquhart: (4) These indicators evaluate ambient condition and allow examination of trends.

3) To what extent do you think the indicator meets the following indicator definition:

*An “indicator” is a numerical value derived from actual measurements of a pressure, ambient condition, exposure, or human health or ecological condition over a specified geographic domain, whose trends over time represent or draw attention to underlying trends in the condition of the environment.*

1	2	3	4
Doesn't meet the definition	Only partly meets the definition	Largely meets the definition	Fully meets the definition

Creal: (4) This indicator clearly meets the definition of a numerical valued derived from actual measurements of an ambient condition. However, there is variation due to flow fluctuations that must be taken into account when interpretations are made. This is well explained in the supporting documentation.

Paerl: (3) This indicator reflects key pressures (N, P loads, concentrations) that impact ambient conditions. Good linkage to habitat effects and condition, but no direct linkages except for possibly HABs and hypoxia) to human health effects.

Pawley: 3) Largely meets the definition as a measure of a pressure and ambient condition of N and P. The trends over time draw attention to condition; however, earlier measurements if available might elucidate better actual conditions relative to undisturbed conditions as fertilizers and sewage problems have been problems for many decades. In addition, the addition of data from other large rivers would improve the indicator.

Urquhart: (4) These indicators combine objective measures of concentrations and flows.

4) To what extent do you think the indicator meets each of the following indicator criteria:

- a) The indicator makes an important contribution to answering a question for the ROE. (In this context, “important” means that the indicator answers a substantial portion of and/or a critical part of the question.)

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (3)  
Paerl: (3)  
Pawley: (3)  
Urquhart: (4)

- b) The indicator is objective. It is developed and presented in an accurate, clear, complete, and unbiased manner.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (4)  
Paerl: (2/3)  
Pawley: (4)  
Urquhart: (4)

- c) The underlying data are characterized by sound collection methodologies, data management systems that protect its integrity, and quality assurance procedures.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (4)  
Paerl: (3)  
Pawley: (4)  
Urquhart: (4)

- d) Data are available to describe changes or trends, and the latest available data are timely.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (4)  
Paerl: (3)  
Pawley: (3)  
Urquhart: (4)



- e) The data are comparable across time and space, and representative<sup>3</sup> of the target population. Trends depicted in this indicator accurately represent the underlying trends in the target population.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (4)  
Paerl: (2/3)  
Pawley: (3)  
Urquhart: (2)

- f) The indicator is transparent and reproducible. The specific data used and the specific assumptions, analytic methods, and statistical procedures employed are clearly stated.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (4)  
Paerl: (3)  
Pawley: (4)  
Urquhart: (4)

Please explain:

Creal: I believe this should be an excellent indicator for the ROE. The supporting documents dealt well with the issue of changes in flows, analytical methods, sampling frequency, and sampling locations. This indicator also summarizes the data well and deals with the issue of rapidly changing stream conditions. This is an excellent way to explain and treat the inevitable changes that will occur over time with all monitoring programs.

Paerl: [no answer provided]

Pawley: Overall, the data and calculations are supportable; however, there are limitations in the geographic extent of the coverage (other large streams and smaller watersheds are not part of the calculation) and certain forms of nitrogen are not included. For example, in coastal areas that I am currently investigating, ammonia may be a better indicator of pollution. Also, to understand conditions relative to more pristine conditions, earlier measures would be desirable in all systems; however, data may not be available.

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<sup>3</sup> An indicator seeks to describe trends in an overall target "population" (e.g., land area, type of surface water, type of emissions, U.S. population), yet data often can only be sampled from a subset of this population. The validity of the trends described by the indicator will depend on the degree to which the sampled population is representative of the target population.

Urquhart: The target population is undefined. In one sense the data applies to only 55% of the country. Selection of monitoring sites is not discussed directly, but they appear to usually be located near stream gauges. These rarely are located on headwater streams or even on second order (Strahler) streams. This indicator tells us virtually nothing about 2/3 of the stream miles in the country.

- 5) Do you have any suggestions for more effective graphic presentation of the data?  
If yes, please describe.

Creal: A spatial map showing the distribution of the watersheds would help inform the reader.

Paerl: Once more information is needed on effects of N and P loadings and roles as limiting nutrients in “transitional ecosystems” in which productivity may be co-limited. These would include large lakes, some rivers, estuarine and near-shore coastal receiving waters. This information should ultimately be conveyed in tables and graphs.

Pawley: One possible improvement or addition would be to compare the trends to the lowest recorded trends and rate the current conditions relative to these measurements for each of the streams as a possible regional measure and in addition, aggregate the ratings for an overall view of “current conditions” in N and P loadings. For example, the Mississippi graph in records conditions for nitrate in the 50’s depicts lower levels in the early 60’s.

Urquhart: The graphic display appropriately explodes that part of the main figure which is obscured by the flow of the Mississippi. If this graphic form is used, investigate putting a light shaded box around the part to be exploded with an arrow pointing to the exploded part of the graph. Consider two other ways to overcome the scale problem caused by the large flow of the Mississippi. There could be two vertical axes, one for the Mississippi, and one on the other side for the other rivers. Alternatively, each series could be scaled by its respective long-term average. This would contrast the different patterns of the four rivers, especially showing the long-term decrease in the Saint Lawrence.

- 6) Please provide any additional comments, suggestions, or concerns regarding the indicator that you have not already noted in Questions 1 through 5. In particular, note any limitations to the indicator that you have not already described in your responses to the preceding questions.

Creal: This indicator has done a nice job dealing with a variety of changing conditions over time, and still provides a useful picture of water quality. I would suggest that the process used here to deal with these issues be considered as other indicators and datasets are looked at, especially when considering how to combine datasets from different state databases. I believe that EPA has a chance to tap into a wealth of information that exists in state databases, and would encourage EPA to do so.

Paerl: See comments pertaining to (5)

Pawley: An additional and important part of the discussion of this indicator should be to better educate the public about our uses of fertilizers and our treatment of sewage over time. How has fertilizer use corresponded to the conditions reflected in this indicator? What improvements have been made in sewage treatment, dairy management, etc.??

Urquhart: The writeup for this indicator presumes that nitrogen and phosphorus in rivers come primarily from anthropogenic sources. (See the next to the last sentence in the second paragraph.) How about natural sources? For example, there are major springs supplying water feeding the Columbia River with phosphorus levels above EPA guidelines as it comes out of the ground. This water has been in volcanic substrates for centuries, long before the potential effects of European settlement, according to USGS.

7) Overall, this indicator:

Creal:   X   Should be included in ROE06 TD.

Paerl:   X   Should be included in ROE06 TD with the modifications identified above.

Pawley:   X   Should be included in ROE06 TD with the modifications identified above.

Urquhart:  XXX  Should be included in ROE06 TD with the modifications identified above.

## Attachment 2: Comment Sheet for Group 1 Indicators

Topic Area: **Water**

Indicator Name: **Nitrate and Pesticides in Groundwater in Agricultural Watersheds**

- 1) Please indicate the extent to which you think the proposed indicator is appropriate, adequate, and useful (AA&U) for evaluating our nation's waters and for contributing to an overall picture of our nation's waters.

1	2	3	4
Indicator is not AA&U	Indicator is of somewhat AA&U	Indicator is largely AA&U	Indicator is completely AA&U

Creal: (2/3) As currently used, this indicator does not make a large contribution. The presentation of the data should be changed, with a focus on nitrate concentrations, spatial trends, and the frequently found five pesticides.

Paerl: (4) Nitrate concentrations and loadings are among the most useful and direct indicators of human density and activity in agricultural watersheds. Nitrate inputs to natural waters are of direct relevance to the productive status (trophic state) and water quality. There are many strong, direct and indirect relationships between nitrate loading and eutrophication of natural waters. This is especially true for estuarine and coastal waters.

Pawley: (3) The proposed indicator is entirely appropriate as nutrient contamination is a widespread problem in groundwater; however, I think the indicator will be more informative with the modifications suggested below.

Urquhart: (2) Indicator is marginally relevant, but analysis and presentation is sorely lacking. "Overall ..." it is not. How about waters other places. Agriculture is presumed to be the only location of such problems.

- 2) Please indicate the extent to which you think the proposed indicator makes an important contribution to answering the specific ROE question it is intended to answer (see Attachment 1 for list of questions). (Note: An indicator may be judged less important if it makes a smaller or less critical contribution to answering the question posed than the other indicators, or if it covers an area of less or diminishing importance environmentally.)

1	2	3	4
Indicator is not important	Indicator is of minor importance	Indicator is important	Indicator is critical

Creal: (4) This indicator is critical to answering the question of the condition of the groundwater. This is an area where data is lacking in many areas of the country.

Paerl: (4)

Pawley: (3) This is an important issue, but perhaps an even more important issue for groundwater is the extent to which we are depleting this resource. If it is not included elsewhere, an indicator needs to be developed for “groundwater quantity and extent”.

Urquhart: (2) Not a national indicator, but gives an indication of a potentially important health effect.

3) To what extent do you think the indicator meets the following indicator definition:

*An “indicator” is a numerical value derived from actual measurements of a pressure, ambient condition, exposure, or human health or ecological condition over a specified geographic domain, whose trends over time represent or draw attention to underlying trends in the condition of the environment.*

1	2	3	4
Doesn't meet the definition	Only partly meets the definition	Largely meets the definition	Fully meets the definition

Creal: (2) This indicator has no temporal representation. In addition, there is substantial interpretation involved with the use of the various endpoints such as MCL, RDS and HA-L. Finally, there is the issue of what constitutes an agricultural watershed, and what bearing that would have on the groundwater in the vicinity.

Paerl: (3) This indicator is a direct measure of pressure, ambient condition and ecological condition. It is less directly and in many instances inconclusively, linked to exposure and human health, in large part because in most ecosystems, concentrations fall far below the threshold of any detectable acute impacts on human health. There may be chronic impacts, but those have yet to be identified and determined.

Pawley: (2) The indicator addresses an important issue; however, as it is presented only partly addresses the indicator definition because it averages trends over the entire period. It appears that this was done out of necessity because of NAWQA's sampling design; however, the reference material indicated at least two sampling cycles, so I am unclear why the data were averaged.

Also, like the surface water comparison noted in the last indicator, a more interesting portrayal of this information would be a comparison of these values in agricultural watersheds with those watersheds without agriculture (see figure 1 above showing this comparison from the Heinz Center website).

Urquhart: (4) Measures an ambient condition over specified geographic domains.

4) To what extent do you think the indicator meets each of the following indicator criteria:

- a) The indicator makes an important contribution to answering a question for the ROE. (In this context, “important” means that the indicator answers a substantial portion of and/or a critical part of the question.)

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (4)  
Paerl: (3)  
Pawley: (2)  
Urquhart: (2)

- b) The indicator is objective. It is developed and presented in an accurate, clear, complete, and unbiased manner.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (2)  
Paerl: (4)  
Pawley: (3)  
Urquhart: (2)

- c) The underlying data are characterized by sound collection methodologies, data management systems that protect its integrity, and quality assurance procedures.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (4)  
Paerl: (4)  
Pawley: (4)  
Urquhart: (4)

- d) Data are available to describe changes or trends, and the latest available data are timely.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (2)

Paerl: (2) Again, this largely depends on the length and spatial extent of data base.

Pawley: (1)

Urquhart: (4)

- e) The data are comparable across time and space, and representative<sup>4</sup> of the target population. Trends depicted in this indicator accurately represent the underlying trends in the target population.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (4)

Paerl: (3)

Pawley: (2)

Urquhart: (1)

- f) The indicator is transparent and reproducible. The specific data used and the specific assumptions, analytic methods, and statistical procedures employed are clearly stated.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (3)

Paerl: (4)

Pawley: (3)

Urquhart: (4)

Please explain:

Creal: There is considerable chance to introduce bias, first in the selection of the agricultural watersheds, and their relationship with the groundwater. There are no temporal trends associated with this indicator, and the data are now about 10 years old.

Paerl: [no answer provided]

Pawley: It is important to present trends, regional values and comparisons in non-Agricultural systems, and to include information regarding where data were collected.

For pesticides, a more advanced method such as the CCME method could be attempted.

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<sup>4</sup> An indicator seeks to describe trends in an overall target "population" (e.g., land area, type of surface water, type of emissions, U.S. population), yet data often can only be sampled from a subset of this population. The validity of the trends described by the indicator will depend on the degree to which the sampled population is representative of the target population.

Urquhart: The document provided to the peer reviewers does not appear to address the issue of what the target population is. The NAWQA data supports a study of trends in the analytes, because most of the wells were revisited during the study time frame.

By its inclusion this indicator implicates agriculture without any recognition that ground water could be contaminated in a number of other ways. And nitrates occur naturally some places. Some cities use well water for most of their domestic water. Why wasn't information from such wells included?

5) Do you have any suggestions for more effective graphic presentation of the data?  
If yes, please describe.

Creal: Yes. For this indicator, the whole country should be described as data are available, at least in a spatial context so the readers can readily understand various levels of nitrate in the groundwater. The nitrate figure should be redone to represent concentrations by frequency of occurrence. The pesticides portion should be refocused on the five frequently found pesticides, and the apparent good news that only about 1% of the wells sampled had any exceedance of any of the endpoints used.

Paerl: It would be useful to present (where available) groundwater and in stream nitrate data on a regional scale, especially for large river watersheds like the Mississippi, and for estuarine and coastal watersheds (Chesapeake, Albemarle-Pamlico, Florida Bay, San Francisco Bay, Puget Sound, etc.).

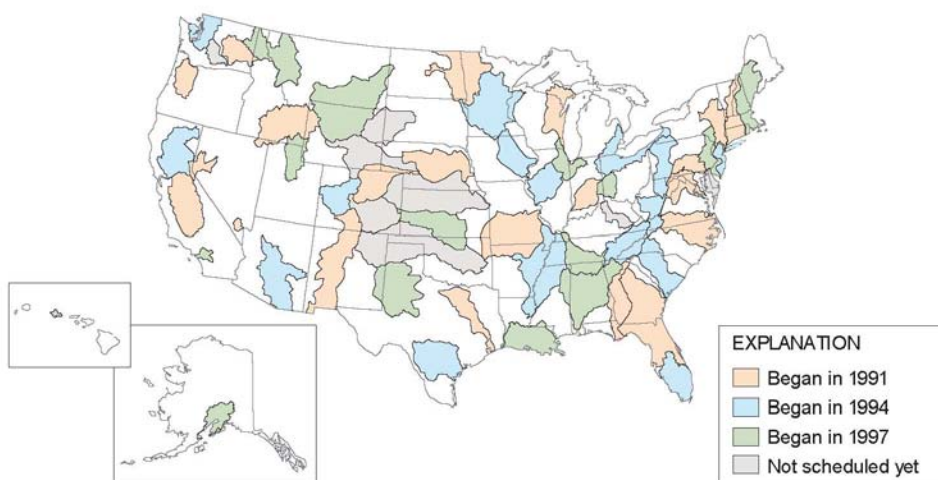
Pawley: Yes...For,

*Nitrates*: one idea might be a plot that compares percentages across regions accompanied with a map and information on regional level "pristine levels" for nitrates. Also break up sampling cycles for more depth in understanding "trends". Even if there is no apparent trend, this is useful information. Include in the legend the number of samples and data source and website.

*Pesticides*: Same concept, but also try alternative index development methods such as the CCME.

Urquhart: A map of the basins to which the data relates would be very informative. I (nsu) extracted the map below from USGS Circular 1165. Better maps probably exist.





- 6) Please provide any additional comments, suggestions, or concerns regarding the indicator that you have not already noted in Questions 1 through 5. In particular, note any limitations to the indicator that you have not already described in your responses to the preceding questions.

Creal: Groundwater datasets are extremely limited in many areas of the country. This is an area where EPA has not pushed as hard for data to be developed as it has in the surface water area. This is likely due to the focus of the Clean Water Act on surface waters, and no comparable focus on the groundwater of the country. I suggest that EPA closely examine their experience on the surface water side, determine what groundwater indicators are needed, and then establish a monitoring program to gather the information in conjunction with the states. This would be appreciated in many states, including Michigan, where there is a well developed surface water monitoring program, but no comparable groundwater monitoring program.

Paerl: [no answer provided]

Pawley: [no answer provided]

Urquhart: This indicator summarizes a report prepared by others for other purposes. The information presented is sorely lacking relative to the information available. Two matters need to be addressed: target population and analysis. The target population certainly is something like all of the subsurface water below 100' accessible as possible drinking water. A summary by frequency of wells does not address this target population. The sampling design underlying the NAWQA survey appears to be a stratified nearly random sample. Within strata frequency of presence of various analytes estimates the amount of water having those levels of analytes. If strata were sampled at different rates, as I (nsu) suspect they were, then regional and national estimates of contaminated water can be obtained by combining the strata frequencies using the relative sampling rates across strata. That should be done!

Secondly, the use of summary data rather than the original data poses severe limitations on achieving EPA's trend-related objective. The original data supports trend estimates across time at the individual well level. The original data should be obtained and analyzed for trends.

NOTE: NSU will have a copy of USGS Open-File Report 95-398 at the meeting. This documents a lot of the NAWQA methods behind this indicator.

7) Overall, this indicator:

Creal: \_\_X\_\_ Should be included in ROE06 TD with the modifications identified above.

Paerl: [no answer provided]

Pawley: \_\_X\_\_ Should be included in ROE06 TD with the modifications identified above.

Urquhart: \_\_XXX\_\_ Should be included in ROE06 TD with the **substantial** modifications identified above.

## Attachment 2: Comment Sheet for Group 1 Indicators

Topic Area: **Water**

Indicator Name: **Wetland Extent, Change, and Sources of Change**

- 1) Please indicate the extent to which you think the proposed indicator is appropriate, adequate, and useful (AA&U) for evaluating our nation's waters and for contributing to an overall picture of our nation's waters.

1	2	3	4
Indicator is not AA&U	Indicator is of somewhat AA&U	Indicator is largely AA&U	Indicator is completely AA&U

Creal: (4) This is a good indicator for the extent of wetlands, although it is only done every 10 years. The reasons for conversion of wetlands does seem to be somewhat subjective, though.

Paerl: (4)

Pawley: (3) This is an important issue; however, the question should be more specific: "What is the current extent and trends in extent of wetlands?" The indicator does not specifically address wetland condition or quality. Future iterations of the index could include aspects of fragmentation and edge effects. Also, there are some remote sensing techniques that could be incorporated to assess vegetation "health" though these are more experimental

Urquhart: (4) Solid, relevant indicator

- 2) Please indicate the extent to which you think the proposed indicator makes an important contribution to answering the specific ROE question it is intended to answer (see Attachment 1 for list of questions). (Note: An indicator may be judged less important if it makes a smaller or less critical contribution to answering the question posed than the other indicators, or if it covers an area of less or diminishing importance environmentally.)

1	2	3	4
Indicator is not important	Indicator is of minor importance	Indicator is important	Indicator is critical

Creal: (4) The extent of wetlands is absolutely a critical indicator in tracking trends in the environment.

Paerl: (4)

Pawley: (4)

Urquhart: (4) Directly addresses ambient extent, trends in extent, and sources of change.

3) To what extent do you think the indicator meets the following indicator definition:

*An “indicator” is a numerical value derived from actual measurements of a pressure, ambient condition, exposure, or human health or ecological condition over a specified geographic domain, whose trends over time represent or draw attention to underlying trends in the condition of the environment.*

1	2	3	4
Doesn't meet the definition	Only partly meets the definition	Largely meets the definition	Fully meets the definition

Creal: (4) The extent of wetlands fully meets the definitions. However, the second part of the indicator, reasons for conversion, seems somewhat subjective, although this is helpful information to track reasons for trends. The reasons for conversion does not span the same time period as the extent of wetlands indicator, only being available for the most recent time period.

Paerl: (3) While this indicator is not necessarily a direct measure of pressure, it is perhaps one of the most useful for describing and delineating ambient and (potentially) ecological condition. It is less directly linked to exposure and human health, in large part because the connection between the amount and proportion of wetland is difficult (and inappropriate) to extrapolate to human health. There may be numerous indirect impacts, such as the (effects on the) ability of wetlands to process and remove pollutants and effects on natural resources and foods such as finfish and shellfish.

Pawley: (4) The indicator is important and depicts trends. I think showing trends on a regional basis would also be a useful addition to this indicator.

Urquhart: (4) Direct measures of area

4) To what extent do you think the indicator meets each of the following indicator criteria:

- a) The indicator makes an important contribution to answering a question for the ROE. (In this context, “important” means that the indicator answers a substantial portion of and/or a critical part of the question.)

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (4)

Paerl: (4)

Pawley: (3)

Urquhart: (4)

- b) The indicator is objective. It is developed and presented in an accurate, clear, complete, and unbiased manner.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (3)  
 Paerl: (4)  
 Pawley: (3)  
 Urquhart: (4)

- c) The underlying data are characterized by sound collection methodologies, data management systems that protect its integrity, and quality assurance procedures.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (3)  
 Paerl: (4)  
 Pawley: (3)  
 Urquhart: (4)

- d) Data are available to describe changes or trends, and the latest available data are timely.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (3)  
 Paerl: (4)  
 Pawley: (3)  
 Urquhart: (4)

- e) The data are comparable across time and space, and representative<sup>5</sup> of the target population. Trends depicted in this indicator accurately represent the underlying trends in the target population.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

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<sup>5</sup> An indicator seeks to describe trends in an overall target "population" (e.g., land area, type of surface water, type of emissions, U.S. population), yet data often can only be sampled from a subset of this population. The validity of the trends described by the indicator will depend on the degree to which the sampled population is representative of the target population.

Creal: (4)

Paerl: (3) Not very applicable due to the nature of the indicator

Pawley: (2)

Urquhart: (4)

- f) The indicator is transparent and reproducible. The specific data used and the specific assumptions, analytic methods, and statistical procedures employed are clearly stated.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (4)

Paerl: (4)

Pawley: (3)

Urquhart: (4)

Please explain:

Creal: This response is for the extent of wetlands. This is generally a very good indicator. However, there are issues with the timeliness of the data, since the inventory is only done every 10 years, and the subjective nature of the reasons for conversion portion of the indicator.

Paerl: [no answer provided]

Pawley: *Extent:* Though the indicator, as presented, is clear and understandable and the likely the best that can be developed at the present time, I did not give the indicator perfect scores because of the issues that are so clearly stated under "indicator limitations". The NWI underestimates certain wetland types, does not count small areas, has changed its methodology, and does not include much of the nation's area (Alaska and Hawaii). These issues should be resolved and the NWI fully funded so it can continue to improve its mapping techniques. Also, it is my understanding that early aerial estimates were not available for some regions, so trends may not be comparable from region to region.

There are regional efforts to improve mapping techniques, such as those in the San Francisco Estuary on the west coast (see [www.sfei.org](http://www.sfei.org)). These efforts should be encouraged and supported.

*Sources of Change:* This is a very valuable indicator and should be augmented with Pacific coastal wetland data sources. If possible trends by state would provide more detail and encourage accountability.

Urquhart: Evaluation procedures are well documented and have been consistent across time, in spite of an inaccurate comment EPA's write-up.

- 5) Do you have any suggestions for more effective graphic presentation of the data?  
If yes, please describe.

Creal: I suggest that the scale on Figures 020-2 and 020-3 be extended to 0 on the Y axis. To do otherwise tends to exaggerate the changes. It is important that the reader clearly understand both the magnitude and the proportion of the change in one view of the figures.

I also suggest that the time periods in Figure 020-1 be made consistent with the time periods used in Figures 020-2 and 020-3, since they are from the same data sources. For example, Figure 020-1 indicates the average wetland loss between 1954 and 1974, while Figures 020-2 and 020-3 indicate fairly precise wetland acres for periods like the 1950s and 1970s.

Paerl: Adequate representation of data

Pawley: *Long-term trends graphs:* Yes, in addition to graphics provided, provide pictures of wetland types embedded in or along with the graph so the public can better relate to the resource. Also provide a breakdown by region using maps to summarize information if possible. It would be useful to add an error bar to the NWI estimates for wetland habitat extent estimates.

*Sources of Change, Fig 20-4:* Add a figure caption explaining the reason for different size circles, expand the relative size of circles so they are more readable, and state somewhere what development, agriculture, and silviculture mean in this context. Show units for wetland gains and losses more clearly.

Another concept is to include detail on trends by state in an abbreviated or web-based format.

Urquhart: A map of the sample plots might be useful to some readers.

- 6) Please provide any additional comments, suggestions, or concerns regarding the indicator that you have not already noted in Questions 1 through 5. In particular, note any limitations to the indicator that you have not already described in your responses to the preceding questions.

Creal: I am not certain of the value added from Figure 020-4 to this particular indicator. There is no information for this portion of the indicator other than for the most recent period. This portion of the indicator seems to address the underlying question of why certain changes happen in the indicator, rather than perform as an indicator. At this point in time, I would recommend dropping this portion of the indicator.

Paerl: [no answer provided]

Pawley: [no answer provided]

Urquhart: Under the heading Indicator Limitations, the following statement appears, “As methods and spatial resolution have improved over time, acreage data have been adjusted resulting in changes in the overall wetland base over time. Thus, the evaluation process is evolving, which contributes to reducing the accuracy of the trends observed.” This statement is not accurate. Current procedures and those in place for some time are designed to prevent exactly this problem. Image interpreters are instructed to NOT change boundaries of previously delineated wetlands unless they have convincing evidence that the wetland has been altered.

Secondly, the next NWI report will be out this year. All comments about a 10-year evaluation cycle should be altered to reflect that fact. The updated info should appear in EPA's report. Current indications are that net wetland loss may have ended.

NSU recently participated in a peer review of the methods used by NWI for its 2005 report currently under development, and bases some of his comments on what he learned there.

7) Overall, this indicator:

Creal: ☒ Should be included in ROE06 TD with the modifications identified above.

Paerl: ☒ Should be included in ROE06 TD with the modifications identified above.

Pawley: ☒ Should be included in ROE06 TD with the modifications identified above.

Urquhart: ☒ Should be included in ROE06 TD with the modifications identified above.



## Attachment 2: Comment Sheet for Group 1 Indicators

Topic Area: **Water**  
Indicator Name: **Coastal Habitat Index**

- 1) Please indicate the extent to which you think the proposed indicator is appropriate, adequate, and useful (AA&U) for evaluating our nation's waters and for contributing to an overall picture of our nation's waters.

1	2	3	4
Indicator is not AA&U	Indicator is of somewhat AA&U	Indicator is largely AA&U	Indicator is completely AA&U

Creal: (3) This indicator is a regional indicator, since coastal areas by definition are regional. However, this is a good indicator, and should be used. For this indicator, consideration should be given to making the Great Lakes a separate suite of indicators from the rest of the coastal areas. In this case, the data from the Great Lakes are not the same as the rest of the data used for the indicator.

Paerl: (3) Given the great variability in function and resourcefulness of wetlands, it is difficult, if not impossible to equate the amount of wetlands to the status of water quality, fisheries resource potential and other human uses (i.e. recreational, residential, etc.) of these complex ecosystems. Given these constraints and limitations, this is a very useful indicator on the larger regional scale.

Pawley: (2) The Coastal Habitat Index as it is presented in the write-up provided, is not clear enough for me to make an accurate assessment of whether it is appropriate. After going to the National Coastal Condition Report II for guidance, I discovered that the calculation is based on the average of two loss rates (historic and present). Indices based on ratios are particularly problematic as the source of change is unclear. Consequently, I think the index is of limited value and not as informative as the other wetland habitat extent index provided. There may be some important reason for this calculation as it is presented but I am unable to ascertain it.

Urquhart: (2) It does not take an index to say that coastal condition, as measured by loss of wetlands, is less than historic losses in the Northeast, a little worse than average in the Southeast, a lot worse along the Gulf Coast and very severe along the West Coast. The problem this indicator is intended to address is important, nevertheless.

- 2) Please indicate the extent to which you think the proposed indicator makes an important contribution to answering the specific ROE question it is intended to answer (see Attachment 1 for list of questions). (Note: An indicator may be judged less important if it makes a smaller or less critical contribution to answering the question posed than the other indicators, or if it covers an area of less or diminishing importance environmentally.)

1	2	3	4
Indicator is not important	Indicator is of minor importance	Indicator is important	Indicator is critical

Creal: (4) The extent of wetlands is absolutely a critical indicator in tracking trends in the environment.

Paerl: (4)

Pawley: (2) Question: What are the trends in the extent and condition of wetlands?

The indicator appears highly redundant with the foregoing indicators, less informative and confusing; therefore I think the indicator is a minor importance in answering this question.

Urquhart: (2) Again, distinguish between the problem and the indicator

3) To what extent do you think the indicator meets the following indicator definition:

*An “indicator” is a numerical value derived from actual measurements of a pressure, ambient condition, exposure, or human health or ecological condition over a specified geographic domain, whose trends over time represent or draw attention to underlying trends in the condition of the environment.*

1	2	3	4
Doesn't meet the definition	Only partly meets the definition	Largely meets the definition	Fully meets the definition

Creal: (3) The extent of wetlands fully meets the definitions. However, the Great Lakes part of the indicator seems somewhat subjective. Note: I could not find the documentation of methods used for the Great Lakes portion, other than one sentence in the second paragraph of the first page. All the rest of the discussion, including the QA/QC, seems oriented toward the coastal wetland loss indicator.

Paerl: (3) While this indicator is not necessarily a direct measure of pressure, it is perhaps one of the most useful for describing and delineating ambient and (potentially) ecological condition. It is less directly linked to exposure and human health, in large part because the connection between the amount and proportion of wetland is difficult (and inappropriate) to extrapolate to human health. There may be numerous indirect impacts, such as the (effects on the) ability of wetlands to process and remove pollutants and effects on natural resources and foods such as finfish and shellfish.

Pawley: (2) The Coastal Habitat Index as it is presented in the write-up provided, is not clear enough for me to make an accurate assessment of whether it meets the indicator definition as the explanation of its calculation is confusing. For most of the regions, it appears to be based solely on wetland loss rate compared to an overall average decadal loss rate; however, the write up should be more explicit. Furthermore, the index is calculated differently for the Great Lakes. Though the Great Lakes example appears highly developed (including amphibian abundance and diversity, wetland dependence and diversity, coastal wetland area by type and the effects of water level fluctuations), the inconsistency in how the indexes are calculated for different regions

makes it difficult to compare the results among regions and average them across all of the regions for a national score. This lack of comparability makes me question validity of the indicator table 334-1. I also would like to understand why the regional breakdown differs from the Coastal Condition Index (next index evaluated)

Urquhart: (3) The numerical value is derived from an objective measurement. Why not show the measurement?

4) To what extent do you think the indicator meets each of the following indicator criteria:

- a) The indicator makes an important contribution to answering a question for the ROE. (In this context, “important” means that the indicator answers a substantial portion of and/or a critical part of the question.)

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (4)

Paerl: (4)

Pawley: (2)

Urquhart: (2)

- b) The indicator is objective. It is developed and presented in an accurate, clear, complete, and unbiased manner.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (3)

Paerl: (4)

Pawley: (2)

Urquhart: (3)

- c) The underlying data are characterized by sound collection methodologies, data management systems that protect its integrity, and quality assurance procedures.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (3)

Paerl: (4)

Pawley: (3)

Urquhart: (4)

d) Data are available to describe changes or trends, and the latest available data are timely.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (3)

Paerl: (4)

Pawley: (3)

Urquhart: (4)

e) The data are comparable across time and space, and representative<sup>6</sup> of the target population. Trends depicted in this indicator accurately represent the underlying trends in the target population.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (4)

Paerl: (3) Not very applicable due to the nature of the indicator

Pawley: (2)

Urquhart: (4)

f) The indicator is transparent and reproducible. The specific data used and the specific assumptions, analytic methods, and statistical procedures employed are clearly stated.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (4)

Paerl: (4)

Pawley: (2)

Urquhart: (3)

Please explain:

Creal: This is generally a very good indicator. However, there are issues with the timeliness of the data, since the inventory is only done every 10 years, and the subjective nature Great Lakes portion of the indicator.

Paerl: [no answer provided]

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<sup>6</sup> An indicator seeks to describe trends in an overall target "population" (e.g., land area, type of surface water, type of emissions, U.S. population), yet data often can only be sampled from a subset of this population. The validity of the trends described by the indicator will depend on the degree to which the sampled population is representative of the target population.

Pawley: The low scores reflect the lack of clarity in the presentation of the index and the inconsistencies noted above. On the other hand, the data is stated to be reliable though many of the same problems noted in the previous index on wetland extent apply here as well, but are not mentioned in the supporting documentation for this index. The calculations are not transparent and they are so aggregated that I think other indicators do a better job of addressing the question posed.

Urquhart: The wetlands loss data is based on solid process, but why does it need to be converted to an index? Show historic losses and recent losses, and talk about them.

5) Do you have any suggestions for more effective graphic presentation of the data?  
If yes, please describe.

Creal: Maps of the areas indicating the rate of wetland loss by area would be beneficial to supplement the indicator. This type of presentation was done in the supporting report, and was much easier to understand the geographical areas involved.

Paerl: Data/indices should also be provided plotted for complex ecosystems, such as Long Island Sound, Chesapeake Bay, Albemarle-Pamlico Sound, Florida Bay, San Francisco Bay, Puget Sound

Pawley: Yes, show the geographic breakdown for the regions. Make the Great Lakes portion of the index consistent with the others.

Urquhart: Show the losses around a map of the country.

6) Please provide any additional comments, suggestions, or concerns regarding the indicator that you have not already noted in Questions 1 through 5. In particular, note any limitations to the indicator that you have not already described in your responses to the preceding questions.

Creal: This indicator is difficult to understand as presented without carefully studying the underlying data and reports. The presentation and wording need to be redone to make it easily understood. Also, the Great Lakes portion of this indicator either needs to be reworked to be compatible with the rest of the data used, or removed from this indicator. Here again, I think the case is made for a separate suite of indicators for the Great Lakes.

Paerl: [no answer provided]

Pawley: The modifications made should be substantial. The indicator should report on certain types of coastal habitats including intertidal wetlands and mudflats. A Coastal Habitat Index might also include a section on SAV, which is currently proposed as a separate index.

It appears that this index is based on some important concepts and the Great Lakes in particular may be ahead of the nation in assessing wetland quality. The measurements included in the Great Lakes portion of the index calculation should be reviewed, adapted and taken to a wider geographic level. In addition, there are numerous rapid assessment methods that should be evaluated to use on a national level. The Ohio Rapid Assessment Method and the California Rapid Assessment Method are example of these techniques. A recent review supported by EPA

of Wetland Rapid Assessment methods should be consulted to begin an effort to evaluate wetland quality in more holistic and consistent fashion across states.

As an aside, I think that the Great Lakes should be considered as part of a freshwater wetland extent and/or quality indicator instead of a coastal habitat indicator.

Urquhart: The person writing this apparently does not understand the difference between NWI's mapping program and its status and trends program. The maps play no role in the status and trends program. Comments about the mapping program have no place in this documentation, but appear in the indicator limitations and in T4Q2 and Q3.

The Table shows all of the US as having a Condition Score of 1.7, but the second line of the text section entitled "What the Data Show" has it as 1.0 If these values are not intended to be the same, explain why.

7) Overall, this indicator:

Creal:   X   Should be included in ROE06 TD with the modifications identified above.

Paerl: [no answer provided]

Pawley:   X   Should be included in ROE06 TD with the modifications identified above.

Urquhart:   XXX   Should be included in ROE06 TD with the modifications identified above.

## Attachment 2: Comment Sheet for Group 1 Indicators

Topic Area: **Water**  
Indicator Name: **Coastal Condition Index**

- 1) Please indicate the extent to which you think the proposed indicator is appropriate, adequate, and useful (AA&U) for evaluating our nation's waters and for contributing to an overall picture of our nation's waters.

1	2	3	4
Indicator is not AA&U	Indicator is of somewhat AA&U	Indicator is largely AA&U	Indicator is completely AA&U

Creal: (2) This index is based on five other indices, of which the sediment quality index does not seem appropriate. Also, the Great Lakes portion does not seem to fit with the rest of the index. Consideration should be made of creating a separate indicator for the Great Lakes, perhaps breaking this indicator into a Great Lakes indicator, with separate indicators for each Great Lake, similar to what was done by region for the coastal areas. I have some reservations about including this indicator in the report. Also, if kept, I believe this indicator should be an effects indicator, instead of an ambient indicator.

Paerl: (3) There is great variability in structure, size, function and resourcefulness of coastal ecosystems, and the diversity of characteristics/parameters (water quality, sediment quality, benthic condition, fish tissue contaminants) that have been synthesized in the development and evaluation of the index, inter-system and regional comparisons based on composite scores (based on the above characteristics/parameters). As a result, it is difficult to apply a uniform set of criteria (let alone comparative values for these criteria) to assign scores for "condition". Differences in hydrologic characteristics, such as flushing rate (residence time) are the basis for a great deal of individuality in terms of sensitivity and susceptibility to stressors, making it very difficult to apply one set of physical-chemical and biological criteria for determining "condition" of coastal ecosystems. Differential human uses (commercial and recreational fishing, aquacultural, recreational, residential, industrial) of these complex ecosystems further complicate designations of "condition" based on these criteria. Despite these local and individual ecosystem constraints and limitations, this is a useful indicator on the larger regional scale, as it reasonably well represents geographic trends in estuarine and coastal water quality condition to urban, agricultural and industrial socioeconomic trends and changes in coastal water- and airsheds.

Pawley: (3) I am perplexed why the ROE indicators are duplicating the indicators found in the National Coastal Condition Report II (NCCR), which is also an EPA publication. This index aggregates the information in the indices that follow and the previous coastal habitat index. Perhaps one way to eliminate so much redundancy is to use only this index in the ROE and refer to the other indicators in the NCCR. The problem though is the high level of aggregation posed here and the fact that I think the coastal habitat index should be reconfigured. Perhaps one way to solve this problem is to change the question to "What is the condition of coastal waters?" and leave the extent to a separate index.

The second criticism I have of this index, is that it is heavily weighted on water quality and benthic communities. A true coastal condition index would include other factors such as biotic integrity of fishes and birds.

Urquhart: (4) This is a true “indicator” which combines many features of the coastal system.

- 2) Please indicate the extent to which you think the proposed indicator makes an important contribution to answering the specific ROE question it is intended to answer (see Attachment 1 for list of questions). (Note: An indicator may be judged less important if it makes a smaller or less critical contribution to answering the question posed than the other indicators, or if it covers an area of less or diminishing importance environmentally.)

1	2	3	4
Indicator is not important	Indicator is of minor importance	Indicator is important	Indicator is critical

Creal: (3) This should be an important indicator, however, there seems to be a lot of subjectivity involved in this indicator. This is because this indicator involves reducing the results from five other indicators.

Paerl: (4)

Pawley: (3) Question: What is the extent and condition of coastal waters? The indicator answers the question about condition of coastal waters and wetland extent, which is a slightly different question.

Urquhart: (3) Not enough time has elapsed for it to measure trend, which is it intended to do.

- 3) To what extent do you think the indicator meets the following indicator definition:

*An “indicator” is a numerical value derived from actual measurements of a pressure, ambient condition, exposure, or human health or ecological condition over a specified geographic domain, whose trends over time represent or draw attention to underlying trends in the condition of the environment.*

1	2	3	4
Doesn’t meet the definition	Only partly meets the definition	Largely meets the definition	Fully meets the definition

Creal: (2) This indicator is an index based on five other indices. Therefore, the numerical value derived (condition score) is fairly well removed from actual measurements. In addition, there is insufficient data for temporal trends.

Paerl: (3)



Pawley: (2/3) With the addition of a trends component, the indicator would more fully meet the indicator definition.

Urquhart: (2) This is a true “indicator” which combines many features of the coastal system. As of now it reflects ambient condition, only, but in the future it can reflect trends.

4) To what extent do you think the indicator meets each of the following indicator criteria:

- a) The indicator makes an important contribution to answering a question for the ROE. (In this context, “important” means that the indicator answers a substantial portion of and/or a critical part of the question.)

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (2)

Paerl: (4)

Pawley: (2)

Urquhart: (4)

- b) The indicator is objective. It is developed and presented in an accurate, clear, complete, and unbiased manner.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (2)

Paerl: (3)

Pawley: (3)

Urquhart: (4)

- c) The underlying data are characterized by sound collection methodologies, data management systems that protect its integrity, and quality assurance procedures.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (3)

Paerl: (4)

Pawley: (3)

Urquhart: (4)

d) Data are available to describe changes or trends, and the latest available data are timely.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (2)

Paerl: (3)

Pawley: (1)

Urquhart: (1)

e) The data are comparable across time and space, and representative<sup>7</sup> of the target population. Trends depicted in this indicator accurately represent the underlying trends in the target population.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (2)

Paerl: (2)

Pawley: (3)

Urquhart: (1)

f) The indicator is transparent and reproducible. The specific data used and the specific assumptions, analytic methods, and statistical procedures employed are clearly stated.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (2)

Paerl: (4)

Pawley: (3)

Urquhart: (4)

Please explain:

Creal: This indicator has all the problems associated with each of the five indices involved. For example, the Coastal Habitat index does not describe the procedures used for the Great Lakes. The Sediment Quality index does not appear to be an appropriate index for use as an indicator. And there are no temporal trends available.

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<sup>7</sup> An indicator seeks to describe trends in an overall target "population" (e.g., land area, type of surface water, type of emissions, U.S. population), yet data often can only be sampled from a subset of this population. The validity of the trends described by the indicator will depend on the degree to which the sampled population is representative of the target population.

Paerl: [no answer provided]

Pawley: The index is highly aggregated so needs to be depicted in a clear way using a method similar to that found in the NCCRII. I have reviewed the write-up there and found it very understandable. In addition to more fully assess condition in the region, the index should incorporate other types of biota and perhaps physical factors, such as erosion potential

Urquhart: This indicator is comparable across space and represents the target population well. However, as it has been evaluated only once, it has no comparability across time, so it does not represent trends across times.

5) Do you have any suggestions for more effective graphic presentation of the data?  
If yes, please describe.

Creal: Maps by each region as presented in the NCC report, in addition to the figure would be beneficial to the reader for understanding where the areas are and what their condition is. The Great Lakes should be removed from this indicator.

Paerl: Data/indices should also be provided and plotted for complex ecosystems that contain important sub-estuaries, such as Long Island Sound, Chesapeake Bay, Albemarle-Pamlico Sound, Florida Bay, San Francisco Bay, Puget Sound. These systems (and their component estuaries) may be quite unique and different from regional status and trends.

Pawley: Yes, Add names of regions, add trends if possible, and show a map of regions.

Urquhart: The graphics in the draft are pathetic! Compare the communication content of Fig 350-1 with National Coastal Condition Report II, Figure 2-1, page 26, which presents the same information.

6) Please provide any additional comments, suggestions, or concerns regarding the indicator that you have not already noted in Questions 1 through 5. In particular, note any limitations to the indicator that you have not already described in your responses to the preceding questions.

Creal: This is a good indicator that needs further development. I recommend removing the sediment quality index from this indicator, and making the Great Lakes a separator indicator.

Paerl: [no answer provided]

Pawley: [no answer provided]

Urquhart: EPA people should utilize their own National Coastal Condition Report II. It makes this presentation look sophomoric!

7) Overall, this indicator:

Creal: \_\_X\_\_ Should be included in ROE06 TD with the modifications identified above.

Paerl: \_X\_ Should be included in ROE06 TD with the modifications identified above.

Pawley: \_\_X\_\_ Should be included in ROE06 TD with the modifications identified above.

Urquhart: **XX**\_ Should be included in ROE06 TD with the modifications identified above..

## Attachment 2: Comment Sheet for Group 1 Indicators

Topic Area: **Water**  
Indicator Name: **Coastal Water Quality Index**

- 4) Please indicate the extent to which you think the proposed indicator is appropriate, adequate, and useful (AA&U) for evaluating our nation's waters and for contributing to an overall picture of our nation's waters.

1	2	3	4
Indicator is not AA&U	Indicator is of somewhat AA&U	Indicator is largely AA&U	Indicator is completely AA&U

Creal: (2) This index is based on five sub-indicators, which are rated high, moderate or low. These ratings are subjective in themselves. The sub-indicator ratings are then combined into one score for a regional area, which in turn are combined into a national coastal water quality condition. I again recommend keeping the Great Lakes in a separate category, and letting the coastal regions represent their area, without combination into a national condition.

Paerl: (3) There is great variability in structure, size, function and resourcefulness of coastal ecosystems, and the diversity of characteristics/parameters (water quality, sediment quality, benthic condition, fish tissue contaminants) that have been synthesized in the development and evaluation of the index, inter-system and regional comparisons based on composite scores (based on the above characteristics/parameters). As a result, it is difficult to apply a uniform set of criteria (let alone comparative values for these criteria) to assign scores for "condition". Differences in hydrologic characteristics, such as flushing rate (residence time) are the basis for a great deal of individuality in terms of sensitivity and susceptibility to stressors, making it very difficult to apply one set of physical-chemical and biological criteria for determining "condition" of coastal ecosystems. Differential human uses (commercial and recreational fishing, aquacultural, recreational, residential, industrial) of these complex ecosystems further complicate designations of "condition" based on these criteria. Despite these local and individual ecosystem constraints and limitations, this is a useful indicator on the larger regional scale, as it reasonably well represents geographic trends in estuarine and coastal water quality condition to urban, agricultural and industrial socioeconomic trends and changes in coastal water- and airsheds.

Pawley: (2) It is useful, as it is presented but does not present a complete view of water quality. The index relies on "conventional water pollutants", water clarity, D.O., nutrients and chlorophyll *a* for which point source regulations including sewage treatment process improvements have made significant improvements in water quality. This is an important story but only part of the picture. For example, in the San Francisco Estuary (west coast), we are finding that other pollutants such as PAH's, PCB's, Mercury, Lead, and PDBE's are the pollutants which need attention (see SFEI's Pulse of the Estuary, 2004 including Pawley and Swanson, 2004 and the Pulse of the Estuary 2005 at [http://www.sfei.org/rmp/pulse/2005/RMP05\\_PulseoftheEstuary.pdf](http://www.sfei.org/rmp/pulse/2005/RMP05_PulseoftheEstuary.pdf)). Many of these pollutants exist at higher levels inland where silt and clay sediments predominate. Consequently, the

coastal water quality index should include additional pollutants including pesticides, metals, PAH's, and PCB's if it is feasible. It is important to include these measures, to tie this index to the fish contaminant index results. I also noticed the presence of these measures in the sediment quality index; do the question is whether these result are sufficient to reflect conditions in the water column.

Urquhart: (None) ALL COMMENTS AND EVALUATIONS THE SAME AS FOR COASTAL CONDITION INDEX.

- 5) Please indicate the extent to which you think the proposed indicator makes an important contribution to answering the specific ROE question it is intended to answer (see Attachment 1 for list of questions). (Note: An indicator may be judged less important if it makes a smaller or less critical contribution to answering the question posed than the other indicators, or if it covers an area of less or diminishing importance environmentally.)

1	2	3	4
Indicator is not important	Indicator is of minor importance	Indicator is important	Indicator is critical

Creal: (3) This should be an important indicator, and needs to be developed as such. However, the Great Lakes portion is based on an entirely different dataset and interpretive criteria.

Paerl: (3) Use of this indicator represents a valuable approach for detecting and characterizing regional-scale changes in water quality and habitat condition. It is relatively insensitive to individual ecosystem changes, unless these are large systems that dominate on the regional scale.

Pawley: (3) *Question:* What is the trend in extent and condition of coastal waters?

It answers an important portion of this question but does not address the issue completely. It should be expanded or presented with additional indicators that include other parameters.

Urquhart: [no answer provided]

- 6) To what extent do you think the indicator meets the following indicator definition:

*An “indicator” is a numerical value derived from actual measurements of a pressure, ambient condition, exposure, or human health or ecological condition over a specified geographic domain, whose trends over time represent or draw attention to underlying trends in the condition of the environment.*

1	2	3	4
Doesn't meet the definition	Only partly meets the definition	Largely meets the definition	Fully meets the definition

Creal: (2) This indicator is an index based on five other sub-indicators. Therefore, the numerical value derived (condition score) is fairly well removed from actual measurements. The endpoints established are somewhat subjective also. For example, the dissolved oxygen endpoints are set at 2 and 5 mg/l, without

much regard for how either endpoint relates to any EPA approved Water Quality Standards for a coastal water body. In addition, the geographical area represented by each result is taken into account as the good-fair-poor results are presented. Then the per cent endpoints are set up entirely arbitrarily. In conclusion, the underlying data are actual measurements, but the indicator is far removed from the underlying data.

Paerl: (3) In most instances, the indicator does not tell us much about human health aspects or ramifications. It may tell us something about ecological condition if the pressure/stress parameter being measured is a direct forcing feature of ecological condition and change. The connection to human health is far less direct and more tenuous in most situations, unless there is a direct tie in between pressure, condition and change therein, and toxic or otherwise harmful algal blooms or outbreaks of pathogens.

Pawley: (2) *Geographic limitation:* the Great Lakes and the hypoxic zone of the Gulf were not included in the index. The report says nearshore estuarine waters were assessed; so it is important to have a fuller explanation of the sampling area in the report. Is this a coastal assessment or an estuarine assessment. If it is estuarine, does it include San Francisco Bay? These areas should be included in future updates.

*Lack of trends:* Though there may not be data to support the inclusion of trends, it is important to address this limitation.

Urquhart: (None)

4) To what extent do you think the indicator meets each of the following indicator criteria:

- g) The indicator makes an important contribution to answering a question for the ROE. (In this context, “important” means that the indicator answers a substantial portion of and/or a critical part of the question.)

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (2)

Paerl: (3)

Pawley: (2)

Urquhart: (None)

- h) The indicator is objective. It is developed and presented in an accurate, clear, complete, and unbiased manner.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (2)  
Paerl: (2/3)  
Pawley: (3)  
Urquhart: (None)

- i) The underlying data are characterized by sound collection methodologies, data management systems that protect its integrity, and quality assurance procedures.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (3)  
Paerl: (3)  
Pawley: (4)  
Urquhart: (None)

- j) Data are available to describe changes or trends, and the latest available data are timely.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (2)  
Paerl: (4)  
Pawley: (2)  
Urquhart: (None)

- k) The data are comparable across time and space, and representative<sup>8</sup> of the target population. Trends depicted in this indicator accurately represent the underlying trends in the target population.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (2)  
Paerl: (2)  
Pawley: (2)  
Urquhart: (None)

- l) The indicator is transparent and reproducible. The specific data used and the specific assumptions, analytic methods, and statistical procedures employed are clearly stated.

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<sup>8</sup> An indicator seeks to describe trends in an overall target "population" (e.g., land area, type of surface water, type of emissions, U.S. population), yet data often can only be sampled from a subset of this population. The validity of the trends described by the indicator will depend on the degree to which the sampled population is representative of the target population.



1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (2)  
Paerl: (3)  
Pawley: (3)  
Urquhart: (None)

Please explain:

Creal: This indicator has all the problems associated with each of the five sub-indicators involved. There is quite a bit of subjectivity involved when assigning the rankings. The endpoints established are not clearly associated with actual effects, or EPA approved Water Quality Standards.

Paerl: [no answer provided]

Pawley: The low ratings given, reflect the lack of a larger array of parameters, the lack of trends data and the fact that some geographic areas are not represented in the index. Also, it would be beneficial to know whether the methods to compare the differing water clarity methods utilized in the analysis are approved through a peer review process.

Urquhart: [no answer provided]

5) Do you have any suggestions for more effective graphic presentation of the data?  
If yes, please describe.

Creal: Maps such as those presented in the NCC report in addition to the figure would be beneficial to the reader for understanding where the areas are and what their condition is.

Paerl: The Condition Score is not very meaningful. What does it really indicate? The data could be presented on a geographic basis, which would have the benefit of the readers seeing where the (relatively) greatest effort (and hence data base) is centered. Also, as mentioned in the "indicator limitations" section, worst case scenarios are likely to be missed or overlooked with the type of data analysis employed here. There is no easy remedy to this, except to examine more systems on a set of close time-space intervals. This has been done in places like Chesapeake Bay and component estuaries of the Albemarle-Pamlico Sound. The data from these systems shows numerous acute/worst case scenarios, and illustrates that such scenarios are more likely to be detected (and characterize) those systems. Data collection from most systems is far too infrequent (annually) to either detect or characterize worst-case scenarios.

Pawley: Figure 332-1 Overall Summary of Condition: Yes, similar to my comments for other indicators, textual names of EPA Regions should be included. Not everyone knows the number and extent of EPA's regions. Also, provide a map showing the regions and show clearly those areas not assessed. The National Coastal Condition report depicts maps. In the legend, remind

the reader which parameters are included in the index. Also include a map of sampling location like that in the NCCRII.

Figure 332-2. Coastal Water Quality, 1997-2000. Place reference condition or conditions in a legend or within each box such as in the D.O. example. It is unclear from this graph if those measures above the regional reference condition are good or bad, except in the case of dissolved oxygen, which is explicit. Also, be consistent in the way colors are applied. Red = bad, green = good... etc. Finally, add regional maps like those in the NCCRII report.

Urquhart: [no answer provided]

- 6) Please provide any additional comments, suggestions, or concerns regarding the indicator that you have not already noted in Questions 1 through 5. In particular, note any limitations to the indicator that you have not already described in your responses to the preceding questions.

Creal: This is a good indicator that needs further development. I recommend making the Great Lakes a separator indicator.

Paerl: [no answer provided]

Pawley: An additional problem with this index that is not often addressed is the fact that this index mixes various stressors and responses together. Chlorophyll *a* responds to the presence of nutrient pollutants and might be considered more of a “biotic indicator” than a water quality indicator, despite the long history of use as a water quality measure.

Also, there are some cases where chlorophyll levels are too low indicating a decline in resources at the base of the food chain (e.g. Sacramento San Joaquin Delta ecosystem on the west coast.) In the Scorecard approach which was developed for San Francisco Bay, we chose to use chlorophyll *a* as a measure of food web integrity and noted a decline or crash in food web resources.

Urquhart: [no answer provided]

- 7) Overall, this indicator:

Creal:   X   Should be included in ROE06 TD with the modifications identified above.

Paerl:   X   Should be included in ROE06 TD with the modifications identified above.

Pawley:   X   Should be included in ROE06 TD with the modifications identified above (*if feasible*). ***OR At least referred to with a link to the NCCRII report.***

Urquhart:   XXX   Should be included in ROE06 TD with the modifications identified above.

## Attachment 2: Comment Sheet for Group 1 Indicators

Topic Area: **Water**  
Indicator Name: **Coastal Sediment Quality Index**

- 1) Please indicate the extent to which you think the proposed indicator is appropriate, adequate, and useful (AA&U) for evaluating our nation's waters and for contributing to an overall picture of our nation's waters.

1	2	3	4
Indicator is not AA&U	Indicator is of somewhat AA&U	Indicator is largely AA&U	Indicator is completely AA&U

Creal: (1) This indicator does not provide useful information, and is not appropriate because of the uncertainties associated with the sediment guidelines, the sediment toxicity tests, and what they represent. The information and indications desired can be better expressed using the benthos and water chemistry results.

Paerl: (2) The representativeness and efficacy of this indicator is largely dependent on how representative 10 day static tests using *Ampelisca abdita* is. Also, whether or not sediments were "toxic" was based on mortality tests with this organism. Sublethal and chronic stress effects of toxicants are not effectively measured using this type of test. In addition, no microbial or plant toxicity tests complement the above bioassays. Hence, it is difficult to determine what the broader habitat and ecosystem ramifications of potential toxicants are.

Pawley: (3) The condition of coastal sediments is an important subject; and I applaud the EPA EMAP/NCA program for developing such indicators. I like the way in which sediment contaminants and toxicity are included in the index; and particularly the fact that the benthic index is a separate index. To me, this keeps the conceptual model underlying the indicator, more straightforward. Despite this, I am concerned about the TOC measure included in this index. Some TOC is good but too much might be bad, so the scaling of this indicator is not trivial. My criticism may be moot, if this difficulty is taken into account; however, the write-up is not explicit enough to ascertain how the indicator was rated. The Puerto Rico consistently had a higher TOC. Could this be a normal geographic response? Also, the reason for including this index in two reports (this and the NCCRII) is unclear.

Urquhart: (None) ALL COMMENTS AND EVALUATIONS THE SAME AS FOR COASTAL CONDITION INDEX.

- 2) Please indicate the extent to which you think the proposed indicator makes an important contribution to answering the specific ROE question it is intended to answer (see Attachment 1 for list of questions). (Note: An indicator may be judged less important if it makes a smaller or less critical contribution to answering the question posed than the other indicators, or if it covers an area of less or diminishing importance environmentally.)

1	2	3	4
Indicator is not important	Indicator is of minor importance	Indicator is important	Indicator is critical

Creal: (2) see previous comment

Paerl: (3) See some of the limitations discussed above

Pawley: (4) Sediment quality is extremely important as many part-time and permanently dwelling use, live in sediments, causing the resuspension of and/or incorporation of toxic compounds in the food chain from sediments.

Urquhart: [no answer provided]

3) To what extent do you think the indicator meets the following indicator definition:

*An “indicator” is a numerical value derived from actual measurements of a pressure, ambient condition, exposure, or human health or ecological condition over a specified geographic domain, whose trends over time represent or draw attention to underlying trends in the condition of the environment.*

1	2	3	4
Doesn't meet the definition	Only partly meets the definition	Largely meets the definition	Fully meets the definition

Creal: (1) There is too much interpretation associated with this indicator, using the sediment guidelines, sediment toxicity tests, and total organic carbon results to construct an index. There have been many instances where the sediment guidelines do not provide valid results conducive for use as an indicator of conditions. The guidelines have proven most useful as a screening tool indicative of the need for further work in a localized area.

Paerl: (2) The numerical values derived from this indicator are difficult to relate to human health or overall ecological condition on either ecosystem or regional scales

Pawley: (3) *Geographic limitation:* The report mentions the lack of Alaska, Hawaii, and the Pacific territories; however, it is not clear if the Great Lakes and the hypoxic zone of the Gulf were included in the index. The report says nearshore estuarine waters were assessed; so it is important to have a fuller explanation of the sampling area in the report.

*Lack of trends:* Though there may not be data to support the inclusion of trends, it is important to address this limitation.

Urquhart: (None)

4) To what extent do you think the indicator meets each of the following indicator criteria:

- a) The indicator makes an important contribution to answering a question for the ROE. (In this context, “important” means that the indicator answers a substantial portion of and/or a critical part of the question.)

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (1)  
Paerl: (3)  
Pawley: (3)  
Urquhart: (None)

- b) The indicator is objective. It is developed and presented in an accurate, clear, complete, and unbiased manner.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (2)  
Paerl: (2/3)  
Pawley: (3)  
Urquhart: (None)

- c) The underlying data are characterized by sound collection methodologies, data management systems that protect its integrity, and quality assurance procedures.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (2)  
Paerl: (3)  
Pawley: (4)  
Urquhart: (None)

- d) Data are available to describe changes or trends, and the latest available data are timely.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (2)  
 Paerl: (3)  
 Pawley: (2)  
 Urquhart: (None)

- e) The data are comparable across time and space, and representative<sup>9</sup> of the target population. Trends depicted in this indicator accurately represent the underlying trends in the target population.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (1)  
 Paerl: (3)  
 Pawley: (3)  
 Urquhart: (None)

- f) The indicator is transparent and reproducible. The specific data used and the specific assumptions, analytic methods, and statistical procedures employed are clearly stated.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (2)  
 Paerl: (2/3)  
 Pawley: (2)  
 Urquhart: (None)

Please explain:

Creal: I have used sediment chemistry and sediment toxicity results on numerous occasions, and have found it necessary to be very cautious in interpreting them. The sediment guidelines do not work in many situations, precisely because of the way they are developed. Sediment toxicity tests are difficult to do enough of to provide adequate spatial representation, and there also is a problem here with interpretation. Overall, these are good tools to address localized issues, but not appropriate for national indicators.

Paerl: [no answer provided]

Pawley: In addition to my comments about the limitations in trends and the geographic coverage of this indicator, the TOC indicator calculation is not transparent. Also, toxicity testing is not very reliable, and represents an on and off switch, the way the indicator is calculated.

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<sup>9</sup> An indicator seeks to describe trends in an overall target "population" (e.g., land area, type of surface water, type of emissions, U.S. population), yet data often can only be sampled from a subset of this population. The validity of the trends described by the indicator will depend on the degree to which the sampled population is representative of the target population.

Consequently, new methods might be tested to accompany or supplant the indicator, including biological toxicity responses in key indicator species. For wetlands and benthic communities, the Pacific Estuarine Ecological Indicators Research Program (PEEIR) on the west coast is testing these techniques. For more information, see [www.bml.ucdavis.edu](http://www.bml.ucdavis.edu).

Urquhart: [no answer provided]

- 5) Do you have any suggestions for more effective graphic presentation of the data?  
If yes, please describe.

Creal: Nothing

Paerl: The data could be presented on a geographic basis, which would have the benefit of the readers seeing where the (relatively) greatest effort (and hence data base) is centered. Also, as mentioned in the “indicator limitations” section, worst case scenarios are likely to be missed or overlooked with the type of data analysis employed here. There is no easy remedy to this, except to examine more systems on a set of close time-space intervals. This has been done in places like Chesapeake Bay and component estuaries of the Albemarle-Pamlico Sound. The data from these systems shows numerous acute/worst case scenarios, and illustrates that such scenarios are more likely to be detected (and characterize) those systems. Data collection from most systems is far too infrequent (annually) to either detect or characterize worst-case scenarios.

Pawley: Figure 333-1 Overall Summary of Condition: Yes, similar to my comments for other indicators, textual names of EPA Regions should be included. Not everyone knows the number and extent of EPA’s regions. Also, provide a map showing the regions and show clearly those areas not assessed. The National Coastal Condition report depicts maps. In the legend, remind the reader which parameters are included in the index. Also include a map of sampling location like that in the NCCRII.

Figure 333-2. Coastal Sediment Quality, 1997-2000. Place reference condition in a legend. Show results using a regional format as well as the overall results.

Urquhart: [no answer provided]

- 6) Please provide any additional comments, suggestions, or concerns regarding the indicator that you have not already noted in Questions 1 through 5. In particular, note any limitations to the indicator that you have not already described in your responses to the preceding questions.

Creal: I did not find any documentation of the supporting Great Lakes data, or how the data were interpreted. Here again, the implication is that the freshwater data available for the Great Lakes are different from the rest of the marine coastal areas, and thus supportive of developing a separate suite of Great Lakes indicators.

Paerl: [no answer provided]

Pawley: [no answer provided]

Urquhart: [no answer provided]

7) Overall, this indicator:

Creal: \_\_X\_\_ Should *not* be included in ROE06 TD.

Paerl: \_\_X\_\_ Should be included in ROE06 TD with the modifications identified above.

Pawley: \_\_X\_\_ Should be included in ROE06 TD with the modifications identified above.

Urquhart: **XXX** Should be included in ROE06 TD with the modifications identified above.



## Attachment 2: Comment Sheet for Group 1 Indicators

Topic Area: **Water**  
Indicator Name: **Coastal Benthic Index**

- 1) Please indicate the extent to which you think the proposed indicator is appropriate, adequate, and useful (AA&U) for evaluating our nation's waters and for contributing to an overall picture of our nation's waters.

1	2	3	4
Indicator is not AA&U	Indicator is of somewhat AA&U	Indicator is largely AA&U	Indicator is completely AA&U

Creal: (3) This appears to be a good indicator, however, specific details on the data collected and its interpretation was difficult to find. Also, the write-up states in one place that "no data are available for the Great Lakes", and the next paragraph states "the Great Lakes were rated as low-moderate". If there are no comparable Great Lakes data, the Great Lakes portion of the indicator should be removed. Once again, this is a case for a separate suite of Great Lakes indicators. Also, the supporting write-up refers in the third paragraph to the sediment quality index, perhaps indicating a mix up in which indicator this portion of the write-up belongs in.

Paerl: (2/3) While representative species are included in the analysis and the analysis itself is technically strong and defensible, this indicator is very much regional as opposed to site-specific. There is a great deal of variability in terms of species (especially representative ones) specificity, sensitivity and responsiveness to environmental stressors. There is a great deal of dependency on ecosystem sensitivity, which is likely to vary with residence time, internal processing of pollutants and other stressors (sediments).

Pawley: (3) The inclusion of this indicator is an important indicator of coastal condition, for these communities have been shown to be responsive to high levels of contaminants, organic enrichment, and oxygen stress.

Urquhart: (None) ALL COMMENTS AND EVALUATIONS THE SAME AS FOR COASTAL CONDITION INDEX.

- 2) Please indicate the extent to which you think the proposed indicator makes an important contribution to answering the specific ROE question it is intended to answer (see Attachment 1 for list of questions). (Note: An indicator may be judged less important if it makes a smaller or less critical contribution to answering the question posed than the other indicators, or if it covers an area of less or diminishing importance environmentally.)

1	2	3	4
Indicator is not important	Indicator is of minor importance	Indicator is important	Indicator is critical

Creal: (3) This indicator is important in answering the specific question, and would be critical except for the questions raised above, and the lack of any temporal representation of the data. This indicator needs to be more fully explained and developed for presentation in the report.

Paerl: (3)

Pawley: (3)

Urquhart: [no answer provided]

3) To what extent do you think the indicator meets the following indicator definition:

*An “indicator” is a numerical value derived from actual measurements of a pressure, ambient condition, exposure, or human health or ecological condition over a specified geographic domain, whose trends over time represent or draw attention to underlying trends in the condition of the environment.*

1	2	3	4
Doesn't meet the definition	Only partly meets the definition	Largely meets the definition	Fully meets the definition

Creal: (2/3) There is a question of interpretation that is unanswered, and the apparent lack of temporal trends. This indicator involves a fair amount of subjective interpretation, which is needed when dealing with biological systems. However, I am not sure why there is such a desire to reduce the information to a regional condition score, and then present an overall U.S. condition score. There may be just as much information gained by presenting the percent of area ratings.

Paerl: (None) This indicator may or may not be indicative of pressure (that depends on factors identified above). It *may* be representative of ambient condition, but that condition can change on time scales that are much shorter than the measurement intervals for this indicator. Considering that this indicator is measured/determined once a year in most systems, certain stress events such as hypoxia may be missed depending on factors like whether the water column was stratified and/or respiration rates of infauna and flora.

Pawley: (2) *Geographic limitation:* The report mentions the lack of Alaska, Hawaii, and the Pacific territories; however, it is not clear if the Great Lakes and the hypoxic zone of the Gulf were included in the index. The report says nearshore estuarine waters were assessed; so it is important to have a fuller explanation of the sampling area in the report.

*Lack of trends:* Though there may not be data to support the inclusion of trends, it is important to address this limitation.

Urquhart: [no answer provided]

4) To what extent do you think the indicator meets each of the following indicator criteria:

- a) The indicator makes an important contribution to answering a question for the ROE. (In this context, “important” means that the indicator answers a substantial portion of and/or a critical part of the question.)

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (4)  
Paerl: (3)  
Pawley: (3)  
Urquhart: (None)

- b) The indicator is objective. It is developed and presented in an accurate, clear, complete, and unbiased manner.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (2)  
Paerl: (3)  
Pawley: (3)  
Urquhart: (None)

- c) The underlying data are characterized by sound collection methodologies, data management systems that protect its integrity, and quality assurance procedures.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (3)  
Paerl: (4)  
Pawley: (4)  
Urquhart: (None)

- d) Data are available to describe changes or trends, and the latest available data are timely.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (1)  
Paerl: (2/3)  
Pawley: (2)  
Urquhart: (None)

- e) The data are comparable across time and space, and representative<sup>10</sup> of the target population. Trends depicted in this indicator accurately represent the underlying trends in the target population.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (3)  
Paerl: (2/3)  
Pawley: (2)  
Urquhart: (None)

- f) The indicator is transparent and reproducible. The specific data used and the specific assumptions, analytic methods, and statistical procedures employed are clearly stated.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (2)  
Paerl: (3)  
Pawley: (3)  
Urquhart: (None)

Please explain:

Creal: I believe this should be an excellent indicator for the ROE. However, I am having difficulty finding the data collected and the interpretation, and any expression of temporal trends. This is causing me to give lower scores in the areas of objectivity and transparency and temporal trends.

Paerl: [no answer provided]

Pawley: In addition to the lack of trends information and areas that are not accessed, there are limitations in the way the index was developed and applied in a portion of the geographic area that needs to be addressed. Specifically, for a portion of the nation, largely the west coast, the indicator is not developed in the same way as the other regions. For some of the regions, the index includes tolerant and sensitive species indicators and for others, the indicator relies on

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<sup>10</sup> An indicator seeks to describe trends in an overall target "population" (e.g., land area, type of surface water, type of emissions, U.S. population), yet data often can only be sampled from a subset of this population. The validity of the trends described by the indicator will depend on the degree to which the sampled population is representative of the target population.

species diversity measures. So, the index is not entirely comparable across the nation. Ongoing research will help address this problem, but has not been incorporated in the index calculation to date.

Urquhart: [no answer provided]

- 5) Do you have any suggestions for more effective graphic presentation of the data?  
If yes, please describe.

Creal: The data should be graphically presented as in the NCC report, and some presentation of the temporal trends (or lack thereof) presented. The indicator here switched from the regions used in the NCC report to EPA Regions, without any explanation that this switch was made or why it was made. I am also not sure why the data are reduce to a condition score – there may be useful presentation of the percent ratings.

Paerl: The data could be presented on a geographic basis, which would have the benefit of the readers seeing where the (relatively) greatest effort (and hence data base) is centered. Also, as mentioned in the “indicator limitations” section, worst case scenarios are likely to be missed or overlooked with the type of data analysis employed here. There is no easy remedy to this, except to examine more systems on a set of close time-space intervals. This has been done in places like Chesapeake Bay and component estuaries of the Albemarle-Pamlico Sound. The data from these systems shows numerous acute/worst case scenarios, and illustrates that such scenarios are more likely to be detected (and characterize) those systems. Data collection from most systems is far too infrequent (annually) to either detect or characterize worst-case scenarios.

Pawley: Figure 048-1 Overall Summary of Condition Based on the Benthic Index: Yes, similar to my comments for other indicators, textual names of EPA Regions should be included. Also, provide a map showing the regions and the locations assessed. The National Coastal Condition report depicts good maps that should be emulated if this indicator is place in this report. In the figure caption remind the reader which parameters are included in the index.

Urquhart: [no answer provided]

- 6) Please provide any additional comments, suggestions, or concerns regarding the indicator that you have not already noted in Questions 1 through 5. In particular, note any limitations to the indicator that you have not already described in your responses to the preceding questions.

Creal: I am confused as to whether there is any data for the Great Lakes, and if so, what data there is. I could find no indication of data or results for the Great Lakes in the NCC report.

Also, biological indicators are very important indicators, but very difficult to put into practice.

The references should be clearly identified as to where one could get the information on the data collected and the interpretation of the data.

Paerl: [no answer provided]

Pawley: [no answer provided]

Urquhart: [no answer provided]

7) Overall, this indicator:

Creal: \_\_X\_\_ Should be included in ROE06 TD with the modifications identified above.

Paerl: \_\_X\_\_ Should be included in ROE06 TD with the modifications identified above.

Pawley: \_\_\_\_X\_\_ Should be included in ROE06 TD with the modifications identified above. ***Or referred to using a web-link to the existing NCCRII report.***

Urquhart: XXX\_ Should be included in ROE06 TD with the modifications identified above.

## Attachment 2: Comment Sheet for Group 1 Indicators

Topic Area: **Water**

Indicator Name: **Extent of Hypoxia in Gulf of Mexico and Long Island Sound**

- 1) Please indicate the extent to which you think the proposed indicator is appropriate, adequate, and useful (AA&U) for evaluating our nation's waters and for contributing to an overall picture of our nation's waters.

1	2	3	4
Indicator is not AA&U	Indicator is of somewhat AA&U	Indicator is largely AA&U	Indicator is completely AA&U

Creal: (2) This is a perplexing indicator for a couple of reasons. First, this is a regional indicator, I believe, for two separate areas. I am unclear as to what the difference is between a regional indicator and what constitutes a national indicator. Second, there are different definitions of hypoxia between the two areas, as the Gulf uses 2.0 mg/l, while the Sound uses 3.0 mg/l to define hypoxia. Also, the indicator is listed as an ecological indicator, but it appears to be a measure of ambient conditions.

Paerl: (2) This indicator is very site specific, highly seasonally sensitive, and not applicable to many estuarine and coastal waters that are stressed, but necessarily (sensitive to) hypoxic or anoxic.

Pawley: (2) As the largest zone of hypoxia, the Gulf of Mexico hypoxia indicator is very important; however, it does not represent the national picture on its own. To construct a more adequate indicator, one should include measures of hypoxia in other areas. For example, dissolved oxygen conditions in other areas are known (i.e., San Francisco Bay, USGS, Cloern *ref*) and should be tracked over time to create comparable indices. A summary indicator could be created using these sources and weighted by the area affected.

Urquhart: (4) Oceanic Hypoxia provides a very solid measure of the effect of nutrients from the land on nearby oceanic waters.

- 2) Please indicate the extent to which you think the proposed indicator makes an important contribution to answering the specific ROE question it is intended to answer (see Attachment 1 for list of questions). (Note: An indicator may be judged less important if it makes a smaller or less critical contribution to answering the question posed than the other indicators, or if it covers an area of less or diminishing importance environmentally.)

1	2	3	4
Indicator is not important	Indicator is of minor importance	Indicator is important	Indicator is critical

Creal: (4) This indicator is critical in answering the question, in spite of several difficulties associated with the present measurement and interpretation of the data. However, this indicator should include other important aquatic areas where hypoxia is an issue, like Lake Erie (unless the Great Lakes are set up with a separate suite of indicators, then Lake Erie hypoxia would be part of that suite of indicators).

Paerl: (2/3) Indicator *may* be of general importance, but this still needs to be determined by more closely examining spatio-temporal linkages of hypoxia potentials to environmental stressors (nutrients and other pollutants, sediments). There are no clear and consistent linkages between trends in the loadings of these stressors and hypoxia potentials even in the GOM and LIS.

Pawley: (3) The concept of hypoxia and our efforts to ameliorate the problem nationwide is a critical aspect of coastal condition; however, there is some overlap with the water quality index that should be evaluated. Perhaps this indicator should be evaluated as an example that fits within the water quality index.

Urquhart: (4) Direct evaluation of an ambient condition on which trends can be tracked.

3) To what extent do you think the indicator meets the following indicator definition:

*An “indicator” is a numerical value derived from actual measurements of a pressure, ambient condition, exposure, or human health or ecological condition over a specified geographic domain, whose trends over time represent or draw attention to underlying trends in the condition of the environment.*

1	2	3	4
Doesn't meet the definition	Only partly meets the definition	Largely meets the definition	Fully meets the definition

Creal: (4) This indicator clearly meets the definition of a numerical valued derived from actual measurements of an ambient condition. The indicator should be clearly shown as an ambient indicator.

Paerl: (2) No clear linkage of this indicator to “pressure” other than freshwater input and vertical stratification. It is a good indicator of ambient condition, and may have ramifications for ecological condition (although over time, changes in ecological condition are not clearly linked to changes in hypoxia potentials in either the GOM or LIS). No clear linkage to human health.

Pawley: (3) This indicator of ambient condition and ecological effects depicts trends in aerial “hypoxia” extent over time (years); however, it does not fully address the national geographic domain. In addition, if these two examples are to be used, they should define “hypoxia” in the same way or be clear about why the definitions differ. Long Island reports events of less than 3.0 mg/l and the Gulf of less than 2.0 mg/l. This difference is odd given the warm (5mg/l) and cold water criteria for D.O.(7mg/l) and the probable differences in temperatures between the sites.

Urquhart: (4) Measures ambient condition.



4) To what extent do you think the indicator meets each of the following indicator criteria:

- a) The indicator makes an important contribution to answering a question for the ROE. (In this context, “important” means that the indicator answers a substantial portion of and/or a critical part of the question.)

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (2)  
Paerl: (2)  
Pawley: (3)  
Urquhart: (4)

- b) The indicator is objective. It is developed and presented in an accurate, clear, complete, and unbiased manner.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (4)  
Paerl: (2)  
Pawley: (4)  
Urquhart: (4)

- c) The underlying data are characterized by sound collection methodologies, data management systems that protect its integrity, and quality assurance procedures.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (3)  
Paerl: (3)  
Pawley: (3)  
Urquhart: (3)

- d) Data are available to describe changes or trends, and the latest available data are timely.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (4)  
Paerl: (1/2)  
Pawley: (4)  
Urquhart: (4)

- e) The data are comparable across time and space, and representative<sup>11</sup> of the target population. Trends depicted in this indicator accurately represent the underlying trends in the target population.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (4)  
Paerl: (1/2)  
Pawley: (2)  
Urquhart: (3)

- f) The indicator is transparent and reproducible. The specific data used and the specific assumptions, analytic methods, and statistical procedures employed are clearly stated.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (4)  
Paerl: (2)  
Pawley: (4)  
Urquhart: (4)

Please explain:

Creal: I believe this should be an excellent indicator for the ROE. However, I am hesitant with regards to this being a regional indicator. In addition, there are a few other issues, such as the differing definitions of hypoxia, the seasonality of the sampling, and the time of day for the sampling. These need to be addressed in developing this indicator.

Paerl: Data are only reproducible if replicated samples are examined at the same time at the same location.

Pawley: The low rating for (e) reflects my belief that the Gulf Coast and Long Island are not fully representative of the nation. Also, my response to (c) reflects that fact that the Gulf sampling regime is far less rigorous than for the Long Island indicator despite the magnitude of

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<sup>11</sup> An indicator seeks to describe trends in an overall target “population” (e.g., land area, type of surface water, type of emissions, U.S. population), yet data often can only be sampled from a subset of this population. The validity of the trends described by the indicator will depend on the degree to which the sampled population is representative of the target population.

the problem. Also there are inconsistent methods of measurement across Gulf coast areas that should be addressed particularly if this is to be a primary component of a “national hypoxia indicator” and not just an example of one element of water quality condition.

Urquhart: Two practicalities lead to my response to c & e: Cruises cannot always go the same places, nor occur at the same time. There seems to be mild disagreement on the definition of hypoxia in relation to measured oxygen. However, I (nsu) regard these as being minor problems. Target population can be inferred to be aquatic animals in shallow water of the northern Gulf of Mexico and Long Island Sound.

5) Do you have any suggestions for more effective graphic presentation of the data?

If yes, please describe.

Creal: No.

Paerl: [no answer provided]

Pawley: Yes, a more comprehensive approach might be presented in a manner similar to the coastal condition indicators or alternatively with a rating for each region and a graphic for each area showing the miles affected each year (same as current graph) except using consistent approaches and graphics from region to region. In addition, the watershed affecting this coastal hypoxic region should be presented and key causal factors.

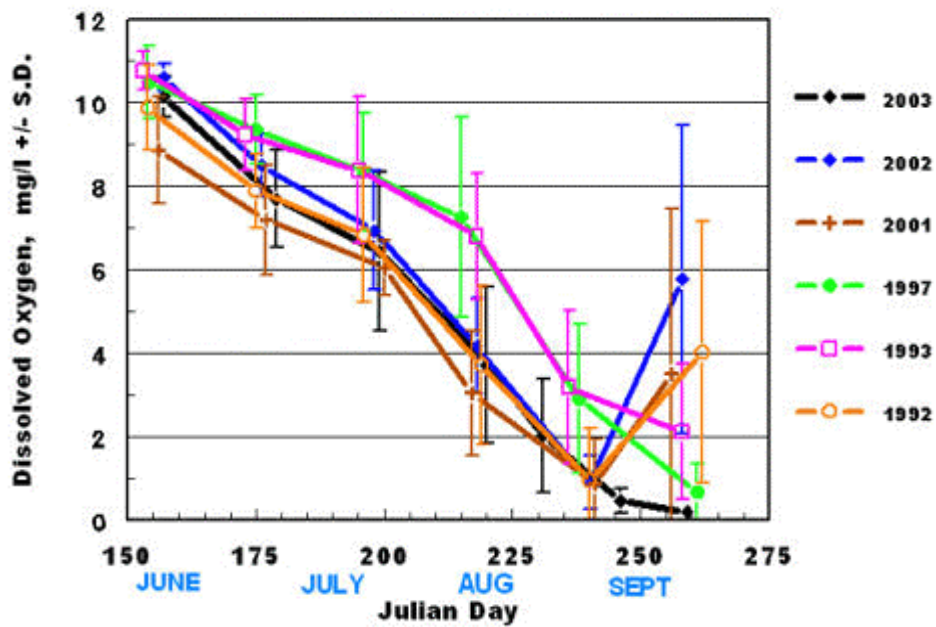
Urquhart: Graphics for this indicator in the draft are very weak compared to what is possible. The National Coastal Condition Report II, the source for much of the information for this indicator, has some very good graphics which should be used. For example, use its figure I-4 to describe the effects of hypoxia. The included graphics have uninformative titles, no axis labels, and poor color choices. What is shown in Fig 238R-1 could be represented on a map much better than the one in Fig 238R-2. For example, the extent of the hypoxia areas could be shown in 2000, 2002 and 2004 to show the shrinkage and expansion of the area.

6) Please provide any additional comments, suggestions, or concerns regarding the indicator that you have not already noted in Questions 1 through 5. In particular, note any limitations to the indicator that you have not already described in your responses to the preceding questions.

Creal: There should be a consistent definition of hypoxia used in the report, or the report should explain why there is a difference in criteria from one area to the next, based on biological endpoints (perhaps by different species in each area). This may be appropriate, but then the issue of differing Water Quality Standards and sampling methodologies between states may be appropriate also, and should be reexamined for inclusion in the ROE.

This indicator should include other areas where hypoxia is an important indicator, and measured on some basis. One example of this would be the “Dead Zone” in central Lake Erie, which has a wealth of data available, as indicated in the graph below. This indicator is explained at <http://www.epa.gov/grtlakes/glindicators/water/oxygenb.html>.

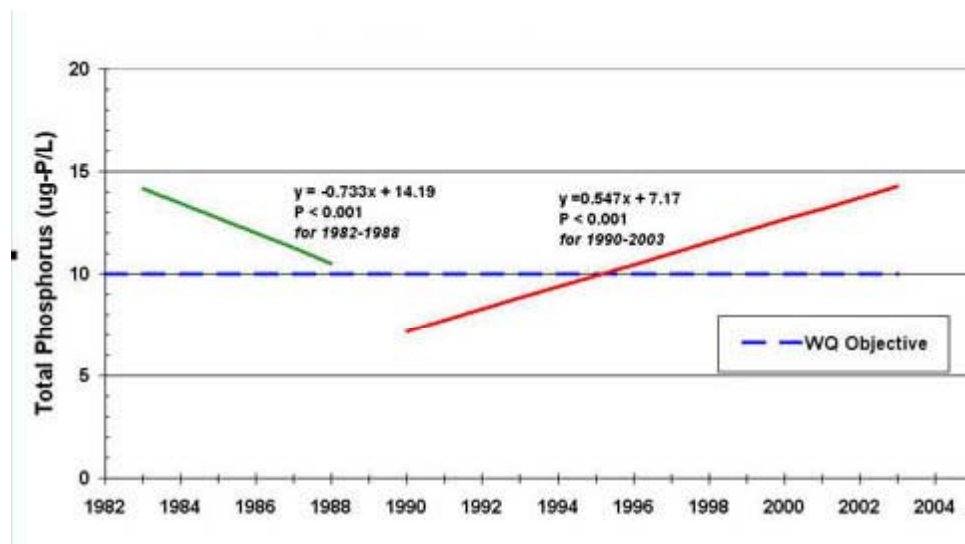
## Dissolved Oxygen Concentration Lake Erie Central Basin Hypolimnion



In addition, there is information available to serve as an indicator of how the limiting nutrient (phosphorus) is acting in Lake Erie. This indicator could either be a pressure or an ambient condition, but would work well coupled with the hypoxia indicator. The summary graph below is from the same data source as the dissolved concentrations shown above.

# Lake Erie Phosphorus

## Central Lake Erie Spring Total Phosphorus Trends



**Goal:** Total Phosphorus in Lake Erie Central Basin should be at or below IJC Water Quality Objective of 10 ug/l

**Status:** Goals is not being met.

**Trends:** Total phosphorus levels have been increasing since the early 1990s

**Issues:** Increasing phosphorus loads and disruptions of food web by aquatic nuisance species may cause future problems in Lake Erie's Central Basin.

This indicator raises the issue again of what constitutes a national indicator versus what is considered a regional indicator. In this case, it seems appropriate to consider that the Great Lakes are a separate “population” of water bodies in the nation, and, as such, may require their own set of indicators.

Paerl: It is questionable whether this indicator actually indicates pressure from pollutant stressors or whether it is an indicator of a variety of interactive factors, including vertical stratification, climatic conditions, trophic state and internal oxygen consuming (respiration) and producing (photosynthesis) processes.

Pawley: One way to accomplish the process of bringing regional datasets together would be to sponsor a small grants program on various indicator topics with specific guidelines and a means for additional input on a national level indicator, which combines these data.

In addition, though the EPA indicators we are tasked with reviewing focus largely on ambient condition and effects, it is important to report on the management actions that are planned and those that have been accomplished to improve hypoxia conditions in the Gulf of Mexico and other areas as appropriate.

Urquhart: [no answer provided]

7) Overall, this indicator:

Creal: \_\_X\_\_ Should be included in ROE06 TD with the modifications identified above.

Paerl: \_\_X\_\_ Should *not* be included in ROE06 TD (at least not as a broad scale regional indicator).

Pawley: \_\_X\_\_ Should be included in ROE06 TD with the modifications identified above.

Urquhart: \_XXX\_ Should be included in ROE06 TD with the modifications identified above

## Attachment 2: Comment Sheet for Group 1 Indicators

Topic Area: **Water**  
Indicator Name: **Harmful Algal Bloom Outbreaks**

- 1) Please indicate the extent to which you think the proposed indicator is appropriate, adequate, and useful (AA&U) for evaluating our nation's waters and for contributing to an overall picture of our nation's waters.

1	2	3	4
Indicator is not AA&U	Indicator is of somewhat AA&U	Indicator is largely AA&U	Indicator is completely AA&U

Creal: (3) This is a regional indicator. I am unclear as to what the difference is between a regional indicator and what constitutes a national indicator. However, this is an appropriate and useful indicator for the Gulf of Mexico.

Paerl: (2) Harmful algal blooms in the near shore waters of the Gulf of Mexico have not been clearly linked to anthropogenic (nutrient overenrichment) environmental pressures or stressors, other than physical factors (stratification, fronts, advective processes) that lead to the introduction of bloom populations in near-shore waters. Some potential linkage to atmospheric iron and nitrogen inputs may be present, but the widespread occurrence and action of such drivers needs to be established. Such blooms appear best linked to changes in the physical states and conditions in offshore and nearshore waters.

Pawley: (2) This is an important topic that should be addressed but without supporting data, one could argue that this is a natural occurrence that we have no means of addressing. Is there supporting data on the causes of harmful algal blooms that would improve the introduction and provide the public with a more credible reason for its inclusion in this document?

Urquhart: (3) We have to guess what the indicator is. Is it the number of Harmful Algal blooms occurring in the near shore waters of the Gulf of Mexico? If so, what is "near shore?"

- 2) Please indicate the extent to which you think the proposed indicator makes an important contribution to answering the specific ROE question it is intended to answer (see Attachment 1 for list of questions). (Note: An indicator may be judged less important if it makes a smaller or less critical contribution to answering the question posed than the other indicators, or if it covers an area of less or diminishing importance environmentally.)

1	2	3	4
Indicator is not important	Indicator is of minor importance	Indicator is important	Indicator is critical

Creal: (4) This indicator is critical in answering the question, in spite of several difficulties associated with the present measurement and interpretation of the data.

Paerl: (2/3) See comments above

Pawley: (3) This indicator is important but harmful algal blooms exist in many other areas of the nation and should be similarly addressed.

Urquhart: (3) The number of ... does tell something about trends in condition, but almost nothing about extent.

3) To what extent do you think the indicator meets the following indicator definition:

*An “indicator” is a numerical value derived from actual measurements of a pressure, ambient condition, exposure, or human health or ecological condition over a specified geographic domain, whose trends over time represent or draw attention to underlying trends in the condition of the environment.*

1  
Doesn't meet  
the definition

2  
Only partly  
meets the definition

3  
Largely meets  
the definition

4  
Fully meets  
the definition

Creal: (4) This indicator clearly meets the definition of a numerical valued derived from actual measurements of an ambient condition. The data are timely, and recent.

Paerl: (2/3) This indicator does reflect certain pressures and ambient conditions, but they are most likely physically-dominated and not linked to anthropogenic activities (possible excluding longterm effects on climate change, which may have an impact on oceanic circulation and stratification.

Pawley: (2) Though the frequency and duration of HAB's in the Gulf is important, the indicator would be more meaningful if an aerial component was included in the indicator calculation. Both duration and extent are important factors affecting the impacts HAB will have on populations. Either the spatial extent affected could be graphed separately or a (spatial extent x duration) HAB parameter could be calculated and reported.

Urquhart: (3) The number does tell us about ambient condition and something about possible animal and human exposure.

4) To what extent do you think the indicator meets each of the following indicator criteria:

- a) The indicator makes an important contribution to answering a question for the ROE. (In this context, “important” means that the indicator answers a substantial portion of and/or a critical part of the question.)



1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (4)  
Paerl: (2)  
Pawley: (2)  
Urquhart: (3)

- b) The indicator is objective. It is developed and presented in an accurate, clear, complete, and unbiased manner.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (4)  
Paerl: (3)  
Pawley: (3)  
Urquhart: (2)

- c) The underlying data are characterized by sound collection methodologies, data management systems that protect its integrity, and quality assurance procedures.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (2/3)  
Paerl: (3)  
Pawley: (3)  
Urquhart: (1)

- d) Data are available to describe changes or trends, and the latest available data are timely.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (4)  
Paerl: (2)  
Pawley: (3)  
Urquhart: (3)

- e) The data are comparable across time and space, and representative<sup>12</sup> of the target population. Trends depicted in this indicator accurately represent the underlying trends in the target population.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (3)  
Paerl: (2/3)  
Pawley: (2)  
Urquhart: (2)

- f) The indicator is transparent and reproducible. The specific data used and the specific assumptions, analytic methods, and statistical procedures employed are clearly stated.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (3)  
Paerl: (2)  
Pawley: (3)  
Urquhart: (4)

Please explain:

Creal: I believe this should be an excellent indicator for the ROE. However, I am hesitant with regards to this being a regional indicator. In addition, there are a few other issues, such as the differing sampling regimes and types between the states. However, this indicator manages to address these differences and put together a useful presentation of the information. Here is an example of how the differences between state programs can be addressed to develop an indicator. EPA should examine how to do this for other datasets that reside in state databases. EPA should also examine how to work with the states to make the differences between states such that these types of data may be combined into larger datasets to advance our understanding of systems such as the Gulf of Mexico.

Paerl: The indicator is only reproducible over close time and space intervals. It is not very reproducible on-an event-to-event basis.

Pawley: The low scores reflect my belief that information from other areas should be presented, that more recent data are available and should be presented, and that the aerial extent should be part of the indicator calculation. Also, the write-up alludes to differences in sampling regimes that should be addressed to improve the calculation. In addition, it appears that some earlier data

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<sup>12</sup> An indicator seeks to describe trends in an overall target “population” (e.g., land area, type of surface water, type of emissions, U.S. population), yet data often can only be sampled from a subset of this population. The validity of the trends described by the indicator will depend on the degree to which the sampled population is representative of the target population.

exists and this should be presented if at all possible to provide a more complete historical picture of trends.

Urquhart: [no answer provided]

- 5) Do you have any suggestions for more effective graphic presentation of the data?  
If yes, please describe.

Creal: The graphs should indicate where the blooms occurred for each bloom. This is presented in the underlying data source cited for EPA for the period 1985-1997 for the nation.

Paerl: [no answer provided]

Pawley: Provide a graph showing frequency and spatial extent over time for a wider range of geographic areas. Combine the graphic with supporting maps for more recent extent as in 237R-2.

Urquhart: Figure 237R-2 has no legend to describe the meaning of the colored and open circles. If it is intended to represent US interests, why are there points way south off Mexico? About an inch could be cropped off each side with no loss of information.

- 6) Please provide any additional comments, suggestions, or concerns regarding the indicator that you have not already noted in Questions 1 through 5. In particular, note any limitations to the indicator that you have not already described in your responses to the preceding questions.

Creal: This indicator raises the issue again of what constitutes a national indicator versus what is considered a regional indicator.

Also, I had a difficult time finding the data used to develop this indicator. The NOAA citation did not come up as a web site, the EPA citation was for national data for the period 1985-1997, and the GSMFC citation had recent 2005 data available by state. From these citations, it is unclear as to what data was used to develop this indicator, and why the recent data up through 2004 are not used. This portion of the supporting documentation needs to be redone and clarified as to what data sources are used.

Paerl: [no answer provided]

Pawley: [no answer provided]

Urquhart: This is best described as episodic data. The target population is completely undefined. How far off-shore does interest lie? There is substantial risk that blooms go unobserved, a fact even noted in the writeup. The issue is certainly important, but the data is very weak relative to usual EPA standards.

The sentence in the second paragraph about 1996 is nearly repeated in the data paragraph. It does not belong both places. The second line of the data paragraph says 14X to x. What is this intended to mean? In the next to the last line of the same paragraph, 2000 omits its trailing 0.

7) Overall, this indicator:

Creal: \_\_X\_\_ Should be included in ROE06 TD with the modifications identified above.

Paerl: \_\_X\_\_ Should *not* be included in ROE06 TD.

Pawley: \_\_X\_\_ Should be included in ROE06 TD with the modifications identified above.

Urquhart: \_XXX\_ Should *not* be included in ROE06 TD.

## Attachment 2: Comment Sheet for Group 1 Indicators

Topic Area: **Water**  
Indicator Name: **Chesapeake Bay Blue Crabs: Mature Females – Spawning Stock Abundance**

- 1) Please indicate the extent to which you think the proposed indicator is appropriate, adequate, and useful (AA&U) for evaluating our nation's waters and for contributing to an overall picture of our nation's waters.

1	2	3	4
Indicator is not AA&U	Indicator is of somewhat AA&U	Indicator is largely AA&U	Indicator is completely AA&U

Creal: (3) This is a regional indicator. I am unclear as to what the difference is between a regional indicator and what constitutes a national indicator. However, I do support the use of these types of indicators, as most indicators will only represent certain regions of the United States. This area is definitely appropriate for a suite of indicators, as is the Gulf of Mexico, and the Great Lakes, for example.

Paerl: (2) This appears to be an appropriate, useful indicator of decline in blue crab habitat (although the complicating effect of fishing pressure is difficult to separate from habitat effects) for regions of Chesapeake Bay, but it has not been thoroughly extrapolated to other systems. Has potential as a local to regional indicator, but not yet tested or proven as a national indicator.

Pawley: (2) Certainly blue crabs are an important species warranting attention for the Chesapeake Bay; but I am perplexed why this one example is being presented instead of the wide range of examples from other coastal areas. The example does not appear to be a particularly strong example of a consistent trend, as the female spawning stock abundance fluctuates around the average. For this example to warrant national attention, its' relationship to key environmental factors should be depicted (i.e., strong correlation with SAV and harvest pressure).

There are many examples of key population indicators across the nation. Taking a wide range of these and aggregating the results would be a more powerful indication of nation-wide trends. I realize this is not a trivial endeavor, but should be attempted. The coastal benthic index (above) is an example of this type of effort. (See indicators for San Francisco Bay ([www.bay.org](http://www.bay.org)); [www.iep.ca.gov](http://www.iep.ca.gov)); Puget Sound, the Gulf of Mexico, Florida).

Urquhart: (2) This indicator is severely geographically limited relative the target population implied by the first sentence of the text related to this indicator. Within the Chesapeake Bay, it may be a very important indicator, but what about bays and estuaries along the East coast where the blue crab lives?

- 2) Please indicate the extent to which you think the proposed indicator makes an important contribution to answering the specific ROE question it is intended to answer (see Attachment 1 for list of questions). (Note: An indicator may be judged less important if it makes a smaller or less critical contribution to answering the question posed than the other indicators, or if it covers an area of less or diminishing importance environmentally.)

1	2	3	4
Indicator is not important	Indicator is of minor importance	Indicator is important	Indicator is critical

Creal: (4) This indicator is critical in answering the question for this particular region.

Paerl: (2/3) See comments above

Pawley: (2) Within the national realm of population responses, I do not believe this is the most important population to highlight. It only answers a small portion of the question, "What is the extent and condition of coastal waters?"

Urquhart: (2) This indicator is severely geographically limited relative the target population implied by the first sentence of the text related to this indicator.

- 3) To what extent do you think the indicator meets the following indicator definition:

*An "indicator" is a numerical value derived from actual measurements of a pressure, ambient condition, exposure, or human health or ecological condition over a specified geographic domain, whose trends over time represent or draw attention to underlying trends in the condition of the environment.*

1	2	3	4
Doesn't meet the definition	Only partly meets the definition	Largely meets the definition	Fully meets the definition

Creal: (4) This indicator clearly meets the definition of a numerical valued derived from actual measurements of an ambient condition, and has a timely and large dataset to work with.

Paerl: (3) This indicator does reflect certain pressures and ambient conditions, but it may be difficult to separate habitat from fishing pressure and or chemical stressor effects. No obvious linkage to human health effects.

Pawley: (3) This is an indicator of Chesapeake Bay condition and an important regional level indicator, but is not a national level indicator.

Urquhart: (2) Still geographic limitation.

4) To what extent do you think the indicator meets each of the following indicator criteria:

- a) The indicator makes an important contribution to answering a question for the ROE. (In this context, “important” means that the indicator answers a substantial portion of and/or a critical part of the question.)

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (4)  
Paerl: (2)  
Pawley: (2)  
Urquhart: (2)

- b) The indicator is objective. It is developed and presented in an accurate, clear, complete, and unbiased manner.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (4)  
Paerl: (3)  
Pawley: (4)  
Urquhart: (4)

- c) The underlying data are characterized by sound collection methodologies, data management systems that protect its integrity, and quality assurance procedures.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (3)  
Paerl: (3)  
Pawley: (4)  
Urquhart: (4)

- d) Data are available to describe changes or trends, and the latest available data are timely.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (4)  
Paerl: (2)  
Pawley: (3)  
Urquhart: (4)

- e) The data are comparable across time and space, and representative<sup>13</sup> of the target population. Trends depicted in this indicator accurately represent the underlying trends in the target population.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (4)  
Paerl: (2/3)  
Pawley: (2)  
Urquhart: (2)

- f) The indicator is transparent and reproducible. The specific data used and the specific assumptions, analytic methods, and statistical procedures employed are clearly stated.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (4)  
Paerl: (3)  
Pawley: (4)  
Urquhart: (1)

Please explain:

Creal: I believe this should be an excellent indicator for the ROE. However, I am hesitant with regards to this being a regional indicator. In addition, there it the issue of differing sampling being conducted for this indicator. However, this indicator does a nice job of bringing together the different datasets into one indicator for the Chesapeake Bay area.

Paerl: The indicator is only reproducible over close time and space intervals. It is not very reproducible on-an event-to-event basis

Pawley: I do not have a problem with the way the indicator is constructed or its importance for the Chesapeake bay ecosystem; however, it seems out of place in this context without the inclusion of other regional examples. In addition, the reference provided on-line indicated that this indicator will be

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<sup>13</sup> An indicator seeks to describe trends in an overall target “population” (e.g., land area, type of surface water, type of emissions, U.S. population), yet data often can only be sampled from a subset of this population. The validity of the trends described by the indicator will depend on the degree to which the sampled population is representative of the target population.



revamped and possibly outdated in its current form. Specifically the document stated that , “A comprehensive update of the blue crab stock assessment is underway and completion is expected in approximately December 2004. It is anticipated that the new assessment will use updated data treatments and methodologies that will render obsolete some of the analyses presented in this and previous CBSAC annual updates.”

Urquhart: Because the indicator is geographically limited it does not represent, “The blue crab represents a valuable commercial fishery across much of the eastern coast of the U.S. fishery.” T4Q1 and T4Q3 are flippant, incomplete, and inaccurate answers. There have to be estimates of variance available from these surveys. In fact the reference to “z-scores” in T4Q1 implies that variances have to be available; without them, Z-scores cannot be computed! “...statistical procedures employed are clearly stated” --- Exactly the opposite is true.

5) Do you have any suggestions for more effective graphic presentation of the data?  
If yes, please describe.

Creal: No.

Paerl: [no answer provided]

Pawley: Showing changes in the crab population relative to a more historic reference condition would be meaningful. The data as presented does not emphasize the fact that crabs have declined.

Showing the female abundance estimate relative to a target or goal if it one exists would provide a more meaningful display of the population results.

Urquhart: Get an overall measure of the variation, and show it on the graph.

6) Please provide any additional comments, suggestions, or concerns regarding the indicator that you have not already noted in Questions 1 through 5. In particular, note any limitations to the indicator that you have not already described in your responses to the preceding questions.

Creal: This indicator raises the issue again of what constitutes a national indicator versus what is considered a regional indicator.

Also, the BCAR 2004 report cited in the references presents several other types of indicators for the blue crabs in Chesapeake Bay. All have similar datasets as the one presented here. There is no discussion as to why this indicator was selected over the other indicators, such as Age 1 exploitable crabs, or Age 0 blue crabs. For this particular document, this discussion would be useful.

Paerl: [no answer provided]

Pawley: [no answer provided]

Urquhart: The nature of the Spawning Female Index is not clear from the supplied text nor from the answers to the prescribed questions. In the event it is a z-score, as suggested by the response to T4Q1, then all of the variation displayed in Figure 320R-1 lies quite close to the zero line.

Specifically, none of the deviations below the zero, including recent ones, even approach any significance level a biologist would use. Any suggestion that there has been any recent decline in the indicator is inappropriate. In fact the recent declines look markedly similar to those seen in the 1970s.

The second paragraph of the text implies that the winter dredge data began being gathered only in 2003, yet T2Q1 says it has been gathered since 1990, or perhaps 1991.

This indicator is very geographically limited if the first text sentence is to be trusted. Either this indicator shouldn't be included, or there should be very strong justification for how the patterns in the Chesapeake mirror those elsewhere on the East coast.

7) Overall, this indicator:

Creal: ☒ **X** Should be included in ROE06 TD.

Paerl: ☒ **X** **May** be included in ROE06 TD with the modifications identified above.

Pawley: ☒ **X** Should *not* be included in ROE06 TD *UNLESS OTHER EXAMPLES INCLUDED*.

Urquhart: ☒ **XXX** Should *not* be included in ROE06 TD.

## Attachment 2: Comment Sheet for Group 1 Indicators

Topic Area: **Water**

Indicator Name: **Submerged Aquatic Vegetation in Chesapeake Bay**

- 1) Please indicate the extent to which you think the proposed indicator is appropriate, adequate, and useful (AA&U) for evaluating our nation's waters and for contributing to an overall picture of our nation's waters.

1	2	3	4
Indicator is not AA&U	Indicator is of somewhat AA&U	Indicator is largely AA&U	Indicator is completely AA&U

Creal: (4) This is a regional indicator. I am unclear as to what the difference is between a regional indicator and what constitutes a national indicator. However, this indicator is completely appropriate for this area of the country.

Paerl: (3) This has been shown to be an appropriate, useful indicator of decline in water column transparency (due to eutrophication, increased sediment load) in Chesapeake Bay and other locations where seagrasses are fairly broadly distributed (Pamlico Sound, Tampa Bay, Indian River Lagoon, FL). This indicator has potential applications nationwide (including the Gulf Coast and West Coast).

Pawley: (2) SAV is an important habitat type across many coastal areas and should be presented for more than Chesapeake Bay. A key question might be, "What are the trends in the extent and distribution of SAV?". There are mapping studies in Florida, Hawaii and California that I am aware of. In California, eelgrass is being mapped in the SF Bay estuary and kelp beds and seagrass communities off the coast; however, we do not yet have a clear indication of historic trends. Equivalent research in other geographic regions should be supported in addition to ongoing Chesapeake Bay studies.

Urquhart: (2) This indicator is severely geographically limited relative the target population implied by the first sentence of the text related to this indicator. Within the Chesapeake Bay, it may be a very important indicator, but what about all of the rest of the aquatic ecosystems implied by the first sentence?

- 2) Please indicate the extent to which you think the proposed indicator makes an important contribution to answering the specific ROE question it is intended to answer (see Attachment 1 for list of questions). (Note: An indicator may be judged less important if it makes a smaller or less critical contribution to answering the question posed than the other indicators, or if it covers an area of less or diminishing importance environmentally.)

1	2	3	4
Indicator is not important	Indicator is of minor importance	Indicator is important	Indicator is critical

Creal: (4) This indicator is critical in answering the question

Paerl: (4) See comments above

Pawley: (3) Aside from the lack of more national coverage, this is a very important indicator.

Urquhart: (2) This indicator is severely geographically limited relative the target population implied by the first sentence of the text related to this indicator.

3) To what extent do you think the indicator meets the following indicator definition:

*An “indicator” is a numerical value derived from actual measurements of a pressure, ambient condition, exposure, or human health or ecological condition over a specified geographic domain, whose trends over time represent or draw attention to underlying trends in the condition of the environment.*

1	2	3	4
Doesn't meet the definition	Only partly meets the definition	Largely meets the definition	Fully meets the definition

Creal: (4) This indicator clearly meets the definition of a numerical valued derived from actual measurements of an ambient condition. It is very appropriate in measuring water quality effects from a variety of sources. As is pointed out in the cited documents, this indicator is not subject to harvest pressures, like the blue crab indicator.

Paerl: (3) This indicator reflects key pressures (nutrient loads, sedimentation) that impacts ambient conditions. Good linkage to habitat condition, but no clear linkage to human health effects.

Pawley: (3) The indicator depicts trends in acres of bay grasses compared to earliest records of historic extent. This is a useful comparison and if possible should be developed for other regions.

Urquhart: (2) Fails miserably on “geographic domain.”

4) To what extent do you think the indicator meets each of the following indicator criteria:

- a) The indicator makes an important contribution to answering a question for the ROE. (In this context, “important” means that the indicator answers a substantial portion of and/or a critical part of the question.)

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (4)  
Paerl: (3)  
Pawley: (3)  
Urquhart: (2)

- b) The indicator is objective. It is developed and presented in an accurate, clear, complete, and unbiased manner.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (3)  
Paerl: (4)  
Pawley: (4)  
Urquhart: (4)

- c) The underlying data are characterized by sound collection methodologies, data management systems that protect its integrity, and quality assurance procedures.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (4)  
Paerl: (4)  
Pawley: (4)  
Urquhart: (3)

- d) Data are available to describe changes or trends, and the latest available data are timely.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (4)  
Paerl: (3)  
Pawley: (3)  
Urquhart: (4)

- e) The data are comparable across time and space, and representative<sup>14</sup> of the target population. Trends depicted in this indicator accurately represent the underlying trends in the target population.

---

<sup>14</sup> An indicator seeks to describe trends in an overall target "population" (e.g., land area, type of surface water, type of emissions, U.S. population), yet data often can only be sampled from a subset of this population. The validity of

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (4)  
Paerl: (None)  
Pawley: (2)  
Urquhart: (2)

- f) The indicator is transparent and reproducible. The specific data used and the specific assumptions, analytic methods, and statistical procedures employed are clearly stated.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (4)  
Paerl: (3)  
Pawley: (4)  
Urquhart: (3)

Please explain:

Creal: I believe this should be an excellent indicator for the ROE. However, I am hesitant with regards to this being a regional indicator.

Paerl: This indicator has been shown to be reproducible in Chesapeake Bay. Has the potential for meeting this criterion in other estuarine and coastal systems, but requires verification.

Pawley: This indicator should be developed for other regions and compared to historic conditions where possible. Again, I do not find a single example for Chesapeake Bay very compelling as an indicator for a national level report.

Though this is a surrogate for water quality, it is also a measure of habitat quality, so the question might be more appropriately, What is the extent and condition of SAV or coastal habitat?

Urquhart: This indicator is based on data which is fairly nearly comparable across time and space, but does not represent the unstated but implied target population.

- 5) Do you have any suggestions for more effective graphic presentation of the data?  
If yes, please describe.

Creal: A spatial map showing the distribution of the SAV would help inform the reader. And the hatched area on the bars should be explained or eliminated. I believe the hatched bars

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the trends described by the indicator will depend on the degree to which the sampled population is representative of the target population.

represent estimated addition acres, but I couldn't determine how this was done. Also, 2004 information is presented in the cited sources and should be added to the graph.

Paerl: Once more data are available for other estuarine and coastal systems, the graphics can be regionalized and plotted for additional systems. Data may already be available for Tampa Bay and parts of Pamlico Sound system?

Pawley: Show a map that illustrates the area assessed in conjunction with the graph. The different colored bars are not explained in a legend and should be.

Another interesting means of presenting the information might be "Percent of historic Extent" so the public can more fully relate to the losses that have occurred. Also, an illustration of SAV types with the graph would assist the reader in visualizing what "SAV" is.

Urquhart: Explain the cross hatched area in the figure; show a map of an early year and a more recent one.

6) Please provide any additional comments, suggestions, or concerns regarding the indicator that you have not already noted in Questions 1 through 5. In particular, note any limitations to the indicator that you have not already described in your responses to the preceding questions.

Creal: This indicator raises the issue again of what constitutes a national indicator versus what is considered a regional indicator.

Paerl: [no answer provided]

Pawley: [no answer provided]

Urquhart: Either remove it, or give a compelling argument for why data from the Chesapeake indexes the state on submerged aquatic vegetation elsewhere.

7) Overall, this indicator:

Creal:   X   Should be included in ROE06 TD.

Paerl:   X   Should be included in ROE06 TD.

Pawley:   X   Should be included in ROE06 TD with the modifications identified above.  
***Include and summarize more regional examples***

Urquhart:   XXX   Should *not* be included in ROE06 TD.

## Attachment 2: Comment Sheet for Group 1 Indicators

Topic Area: **Water**  
Indicator Name: **Population Served by Community Water Systems That Meet All Standards**

- 1) Please indicate the extent to which you think the proposed indicator is appropriate, adequate, and useful (AA&U) for evaluating our nation's waters and for contributing to an overall picture of our nation's waters.

1	2	3	4
Indicator is not AA&U	Indicator is of somewhat AA&U	Indicator is largely AA&U	Indicator is completely AA&U

Creal: (4) This indicator is absolutely appropriate, adequate and useful. However, it is put in the ambient indicator category, where this may be more appropriate as an exposure indicator. Also, it is not clearly explained why Indian Country is portrayed as a separate indicator. This portion seems like it would be best to add in to the rest of the indicator.

Paerl: (2)

Pawley: (2) The concept for this indicator is appropriate as it is important to report on the "safety" of the nation's drinking water system. Many agricultural, industrial and land use activities introduce sediments, pesticides, hydrocarbons, and toxic trace elements into the watershed. However, there many limitations in the importance of this indicator as the water systems tracked by this indicator only serve approximately 10% of the nation's population. (See page 2 of the ROE draft write-up for additional limitations including the fact that bottled water is not included in this indicator.)

For the SF Bay Scorecard ([www.bay.org](http://www.bay.org); Pawley et. al., in prep), we noted similar limitations. We also noted that the data was of variable quality and not necessarily the ideal dataset to use to report on drinking water quality. Frequently there was a lag time in reporting. In addition, the MCL is the highest level of a contaminant that is allowed in the finished treatment process, so this indicator only reflects the quality of treated water and not how much treatment had to occur before the water was palatable. Improvement may reflect discontinued use of contaminated sources rather than clean up of the contaminated water source. Lastly, it would be interesting to include the type of exceedance noted. In the California equivalent of this data, we were able to evaluate the percentage of drinking water suppliers that reported exceedences of drinking water quality standards (maximum contaminant limits, MCLs) in source water supplies for one of five classes of contaminants: nitrogen compounds, heavy metals, pesticides, hydrocarbons, and industrial chemicals.

Urquhart: (4) This indicator reflects an important health-related issue.



- 2) Please indicate the extent to which you think the proposed indicator makes an important contribution to answering the specific ROE question it is intended to answer (see Attachment 1 for list of questions). (Note: An indicator may be judged less important if it makes a smaller or less critical contribution to answering the question posed than the other indicators, or if it covers an area of less or diminishing importance environmentally.)

1	2	3	4
Indicator is not important	Indicator is of minor importance	Indicator is important	Indicator is critical

Creal: (4) This indicator is critical in answering the question. This indicator summarizes a substantial amount of information on drinking water for a substantial portion of the country.

Paerl: (2/3)

Pawley: (3) Question: What are the trends in the quality of drinking water?

The indicator is important but only answers a portion of this question as noted in the limitations above.

Urquhart: (4) This indicator measures both ambient condition, and can be used to evaluate trends.

- 3) To what extent do you think the indicator meets the following indicator definition:

*An “indicator” is a numerical value derived from actual measurements of a pressure, ambient condition, exposure, or human health or ecological condition over a specified geographic domain, whose trends over time represent or draw attention to underlying trends in the condition of the environment.*

1	2	3	4
Doesn't meet the definition	Only partly meets the definition	Largely meets the definition	Fully meets the definition

Creal: (4) This indicator clearly meets the definition of a numerical valued derived from actual measurements of an ambient condition. This indicator also deals well with the changes that have occurred in the MCLs and TT over time. New MCLs are added or changed as warranted, and indicators must be able to deal with these types of changes. However, this does not appear to be the case also with the Indian Country indicator, which only has 2004 data reported.

Paerl: (2) This indicator is mainly relevant to human health, but at present it isn't clear *how* relevant or useful this indicator will be. Needs further development and clarification.

Pawley: (2) The indicator really addresses how effective treatment is and not underlying trends in the environment.

Urquhart: (4) These indicators are either frequencies, or population weighted frequencies.

4) To what extent do you think the indicator meets each of the following indicator criteria:

- a) The indicator makes an important contribution to answering a question for the ROE. (In this context, “important” means that the indicator answers a substantial portion of and/or a critical part of the question.)

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (4)

Paerl: (2)

Pawley: (2)

Urquhart: (4)

- b) The indicator is objective. It is developed and presented in an accurate, clear, complete, and unbiased manner.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (4)

Paerl: (2)

Pawley: (3)

Urquhart: (4)

- c) The underlying data are characterized by sound collection methodologies, data management systems that protect its integrity, and quality assurance procedures.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (3)

Paerl: (2)

Pawley: (3)

Urquhart: (3)

- d) Data are available to describe changes or trends, and the latest available data are timely.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (4)  
Paerl: (2)  
Pawley: (3)  
Urquhart: (3)

- e) The data are comparable across time and space, and representative<sup>15</sup> of the target population. Trends depicted in this indicator accurately represent the underlying trends in the target population.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (3)  
Paerl: (2)  
Pawley: (2)  
Urquhart: (3)

- f) The indicator is transparent and reproducible. The specific data used and the specific assumptions, analytic methods, and statistical procedures employed are clearly stated.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (4)  
Paerl: (2)  
Pawley: (4)  
Urquhart: (4)

Please explain:

Creal: I believe this should be an excellent indicator for the ROE. However, there is an issue with the change in MCLs on occasion, which make temporal trends difficult. Also, the separate Indian Country indicator does not provide the same type of information.

Paerl: [no answer provided]

Pawley: The method of calculation and the supporting data are clearly explained; however, it does not represent a significant portion of the target population or the entire ROE question.

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<sup>15</sup> An indicator seeks to describe trends in an overall target “population” (e.g., land area, type of surface water, type of emissions, U.S. population), yet data often can only be sampled from a subset of this population. The validity of the trends described by the indicator will depend on the degree to which the sampled population is representative of the target population.

Urquhart: These indicators need no statistical inference because the whole (statistical) population is suppose to report. Problems lie in incomplete reporting and are recognized as such. This problem has decreased in recent years.

5) Do you have any suggestions for more effective graphic presentation of the data?  
If yes, please describe.

Creal: Figure 049-2 is too cluttered to understand. Maybe the scale could be cropped to 50-100% to expand the pertinent portion of the graph.

Figure 049-4 is not supported by the same dataset, and it is unclear why this dataset is reported separately. Consideration should be given to combining this dataset with the rest of the data, or explaining why it is reported separately.

Paerl: [no answer provided]

Pawley: Figure 049- 2. Label regions and depict on a map.

Figure 049-3. Improve explanation of this graph in text or eliminate.

Figure 049-4. Label “Indian country” regions and report using the same format as 049-2.

Urquhart: Graphics fine

6) Please provide any additional comments, suggestions, or concerns regarding the indicator that you have not already noted in Questions 1 through 5. In particular, note any limitations to the indicator that you have not already described in your responses to the preceding questions.

Creal: Overall, this is an excellent indicator. However, there is perhaps too much detail attempted with figures 049-2 and 049-4 included. There is no explanation as to why the Indian population is broken out of the rest of the population, or if it is even included in the data used to generate Figure049-1.

I did not see any discussion on the impact of changing MCLs over time, and how the dataset is adjusted for these changes, if it is. This would be a worthwhile discussion, especially to see how this is handled in an indicator report. This situation is common with many standards and criteria, and usually is one of the reasons that standards, especially Water Quality Standards developed by States, are not viewed positively for use in indicator reports like this.

Paerl: [no answer provided]

Pawley: I am unclear why it is necessary to report Indian country violations separately by region. I think the indicator could be used now, only if its lack of coverage of our drinking water systems is addressed in a very visible way in the document. Otherwise, the public will derive a false sense of security from the presentation of this indicator.

Urquhart: None

7) Overall, this indicator:

Creal: \_\_X\_\_ Should be included in ROE06 TD.

Paerl: \_\_\_\_X\_\_ Should *not* be included in ROE06 TD (**maybe in subsequent TDs**).

Pawley: \_\_**X**\_\_ Should be included in ROE06 TD with the modifications identified above.

Note: *I have reservations about including the indicator unless the 10% of our drinking water system is specifically noted.*

Urquhart: **XXX**\_ Should be included in ROE06 TD.

## Attachment 2: Comment Sheet for Group 1 Indicators

Topic Area: **Water**  
Indicator Name: **Coastal Fish Tissue Contaminants Index**

- 1) Please indicate the extent to which you think the proposed indicator is appropriate, adequate, and useful (AA&U) for evaluating our nation's waters and for contributing to an overall picture of our nation's waters.

1	2	3	4
Indicator is not AA&U	Indicator is of somewhat AA&U	Indicator is largely AA&U	Indicator is completely AA&U

Creal: (2) This indicator is a regional indicator, since coastal areas by definition are regional. This indicator is based on EPA guidance for screening values calculated to be protective of human fish consumption. There are a host of assumptions that go into these screening value calculations, including fish consumption rates, various effect levels, and the bioavailability of the contaminant. It is readily acknowledged that PCBs and mercury are the contaminants of national concern. The index should be revised to be a report of trends and levels of PCB and mercury in fish tissue. Consideration should also be given to making the Great Lakes a separate indicator from the rest of the coastal areas, as here again the dataset used for the Great Lakes is different than that used for the marine coastal areas.

Paerl: (3) This indicator is most effective on a regional basis, but relatively insensitive (as currently used) on a system level. This indicator could be useful on a system-level, but data reporting will need to be modified to reflect this capability.

Pawley: (4) This is a very important indicator and the low scores suggest that our other coastal condition indicators may not be rated as stringently; nor do they assess the "sub-lethal affects that may be more accurately reflected by this index.

Urquhart: (4) This indicator reflects a possibly important human and animal exposure. It summarizes the end effect of what has entered the environment from various sources.

- 2) Please indicate the extent to which you think the proposed indicator makes an important contribution to answering the specific ROE question it is intended to answer (see Attachment 1 for list of questions). (Note: An indicator may be judged less important if it makes a smaller or less critical contribution to answering the question posed than the other indicators, or if it covers an area of less or diminishing importance environmentally.)

1	2	3	4
Indicator is not important	Indicator is of minor importance	Indicator is important	Indicator is critical

Creal: (4) The level of fish contaminants, especially PCBs and mercury, is absolutely critical in answering this specific ROE question. However, I would judge the proposed index to be less critical than the absolute levels of PCBs and mercury, and the trends of these contaminants.

Paerl: (2/3)

Pawley: (4) The indicator is critical and it is important to expand it to include trends in the future. It is also important to develop this indicator for freshwater systems.

Urquhart: (4) This indicator relates directly to an important exposure.

3) To what extent do you think the indicator meets the following indicator definition:

*An “indicator” is a numerical value derived from actual measurements of a pressure, ambient condition, exposure, or human health or ecological condition over a specified geographic domain, whose trends over time represent or draw attention to underlying trends in the condition of the environment.*

1  
Doesn't meet  
the definition

2  
Only partly  
meets the definition

3  
Largely meets  
the definition

4  
Fully meets  
the definition

Creal: (2/3) There are many different issues with this indicator as presented here: This index integrates an assessment of a fairly large number of measured contaminants in fish tissue. The indicator makes an adjustment in the measured mercury levels to account for whole body versus edible portion. There are some arbitrary levels set to derive the indicator condition score. The Great Lakes are included yet they clearly don't have a similar dataset as the marine coastal areas. The index only represents one time period, with no indication of temporal trends. I suggest that the indicator refocus on PCB and mercury, and present their values for the nation, and look to develop temporal trend information (I believe this exists in other databases).

Paerl: (3) This indicator is mainly relevant to human health, but at present it isn't clear *how* relevant or useful this indicator will be. Needs further development and clarification.

Pawley: (2) The indicator does not include trends in the analysis and should in future iterations. There are also emerging contaminants, such as PDBE's that should be measured. This has become a significant contaminant in fish and seals in San Francisco Bay.

Urquhart: (2) This index does evaluate exposure over a specific geographic domain, but it apparently has been evaluated only once, so it cannot yet draw attention to underlying trends in the condition of the environment.

4) To what extent do you think the indicator meets each of the following indicator criteria:

- a) The indicator makes an important contribution to answering a question for the ROE. (In this context, “important” means that the indicator answers a substantial portion of and/or a critical part of the question.)

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (3)  
Paerl: (3)  
Pawley: (2)  
Urquhart: (4)

- b) The indicator is objective. It is developed and presented in an accurate, clear, complete, and unbiased manner.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (1)  
Paerl: (3)  
Pawley: (4)  
Urquhart: (4)

- c) The underlying data are characterized by sound collection methodologies, data management systems that protect its integrity, and quality assurance procedures.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (4)  
Paerl: (4)  
Pawley: (3)  
Urquhart: (4)

- d) Data are available to describe changes or trends, and the latest available data are timely.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion



Creal: (2)  
Paerl: (3)  
Pawley: (1)  
Urquhart: (1)

- e) The data are comparable across time and space, and representative<sup>16</sup> of the target population. Trends depicted in this indicator accurately represent the underlying trends in the target population.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (3)  
Paerl: (2)  
Pawley: (3)  
Urquhart: (1)

- f) The indicator is transparent and reproducible. The specific data used and the specific assumptions, analytic methods, and statistical procedures employed are clearly stated.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (2)  
Paerl: (3/4)  
Pawley: (3)  
Urquhart: (4)

Please explain:

Creal: This indicator as proposed relies on a set of assumptions to calculate the screening values, and then applies another set of criteria to develop an index of high, moderate or low. This index needs to move toward a more objective reporting of the levels of the important contaminants, namely PCB and mercury. If there is a desire to compare how the levels in fish compare to a screening value, this could be indicated on a graph of the actual values. This has been readily done with Great Lakes fish contaminant data. Also, it is very disconcerting to have EPA adopt specific regulations for the Great Lakes basin that rely on specific fish tissue values and consumption rates, and then have EPA ignore these specific regulations when indicators are proposed.

Paerl: [no answer provided]

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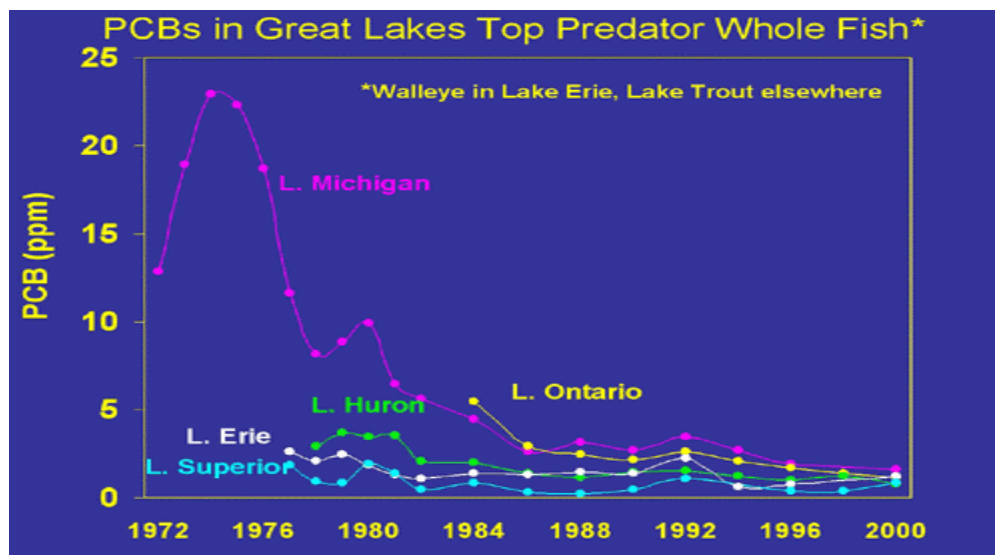
<sup>16</sup> An indicator seeks to describe trends in an overall target "population" (e.g., land area, type of surface water, type of emissions, U.S. population), yet data often can only be sampled from a subset of this population. The validity of the trends described by the indicator will depend on the degree to which the sampled population is representative of the target population.

Pawley: The data presentation was somewhat confusing as the Great Lakes were omitted in the graphic depiction of the Fish Contaminant scores by region, but referred to in the narrative. In addition, the analytical methods vary across the studies, so these inconsistencies should be addressed in future studies. Trends are not available, and it is my understanding that these samples may reflect different time periods.

Urquhart: The indicator is comparable across space and represents the target population of coastal fish about as well as could be hoped for. However, as it has been evaluated only once, it lacks comparability across time, and so it does not represent trends across time.

5) Do you have any suggestions for more effective graphic presentation of the data?  
If yes, please describe.

Creal: A graph of the levels by area and nationally, along with a temporal presentation of the levels of PCBs and mercury should be presented. The use of the index should be discontinued. An example of the PCB data from the Great Lakes is presented as an example:



Paerl: [no answer provided]

Pawley: Figure 335-1 Overall Summary of Condition Based on Fish Tissue Index: Yes, similar to my comments for other indicators, textual names of EPA Regions should be included. Also, provide a map showing the regions and show clearly those areas not assessed. In the legend, remind the reader which parameters are included in the index.

Figure 335-2. Contaminant Concentrations in Fish Tissue. Show results using a regional format as well as the overall results; so that the reader can see which regions are high for which contaminants. Group contaminants by sources if possible and note legacy versus non-legacy contaminants.

Urquhart: The choice of colors in the graphics is poor. The visual contrast between “Within” and “Below” is very limited. The results in Figure 335-1 should be presented on a map of the US showing regions, something like that displayed in the National Coastal Report II, Fig 2-1, page 26. The regions could be colored to reflect the condition score, and the percent of area could be presented as pie charts.

- 6) Please provide any additional comments, suggestions, or concerns regarding the indicator that you have not already noted in Questions 1 through 5. In particular, note any limitations to the indicator that you have not already described in your responses to the preceding questions.

Creal: This index is based on the use of whole fish analyses. There exist several databases of both whole fish and edible portion analytical results, with some databases covering over 20 years. These databases should be carefully evaluated for use, especially for representing areas like the Great Lakes. The use of whole fish data with a conversion factor for mercury severely weakens the use of the data.

Paerl: [no answer provided]

Pawley: [no answer provided]

Urquhart: The comments about PCBs should be expanded. EPA has made a sustained and fairly successful effort to prevent new PCBs from entering the environment. The residual PCBs reflect the lingering effects from contamination of 30+ years ago.

7) Overall, this indicator:

Creal:   X   Should be included in ROE06 TD with the modifications identified above.

Paerl:   X   Should be included in ROE06 TD with the modifications identified above.

Pawley:   X   Should be included in ROE06 TD with the modifications identified above.

Urquhart:   X   Should be included in ROE06 TD with the modifications identified above.

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## **General Comments for Group 1 Indicators**

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### **Attachment 3: Comment Sheet for General Questions for Group 1 Indicators**

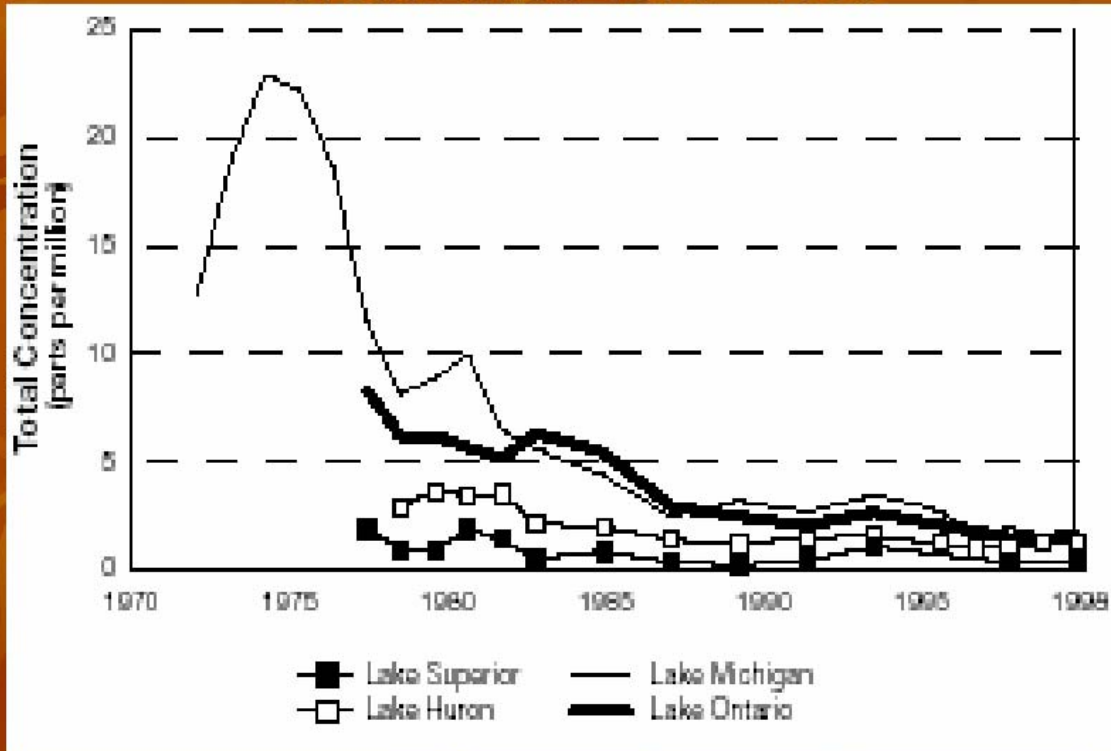
Topic Area: **Water**

- 1) Considering the Group 1 indicators *collectively*, do any of these indicators clearly seem to be more appropriate, adequate, or useful for evaluating our nation's waters or for establishing an overall picture of our nation's waters than others? Do any seem to be more important than the others for answering the question(s) they are intended to answer? (Note: An indicator may be judged less important if it makes a smaller or less critical contribution to answering the question posed than the other indicators or if it covers an area of diminishing interest environmentally.)

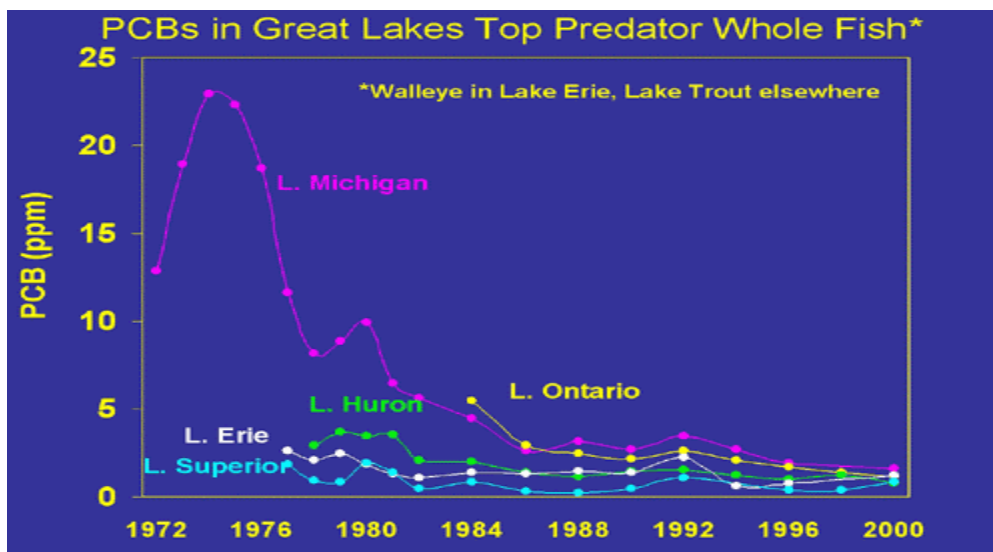
Creal: Yes. I view the following five indicators as more appropriate, adequate, or useful for evaluating our nation's waters: Lake and Stream Acidity (coupled with the Air indicator of acid deposition), Wetland Extent, Change, and Sources of Change, Coastal Benthic Index, Hypoxia in Gulf of Mexico and Long Island Sound, and Population Served by Community Water Systems with No Reported Violations of Health-Based Standards. A secondary group of these indicators includes four indicators: Nitrate and Pesticides in Groundwater in Agricultural Watersheds, Nitrogen and Phosphorus Discharges from Large Rivers, Chesapeake Bay Blue Crabs, and Coastal Fish Tissue Contaminants Index. However, the Nitrate and Pesticides in Groundwater in Agricultural Watersheds needs to be changed as suggested in my comments on that indicator. I would view the Coastal Fish Tissue Contaminants Index as part of the first group if it were revised to reflect the concentrations of PCBs and mercury, instead of a comparison to screening values. For example, the graphs presented below are an example of some of the data available for the Great Lakes:

## Environmental Measures – Ecological Indicators

### PCB Concentration In Lake Trout from Four Great Lakes 1970 - 1998



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Paerl: The indicators that are most appropriate are those that cross ecosystem and regional boundaries most readily, can be used in quantitative comparisons of pressure/stress, ambient and overall ecological condition, and (where applicable) human health condition. Except for the



SAV based indicators, which are likely to be applicable to virtually all habitats that have or are supporting SAVs (due to the uniform light requirements of SAVs and their sensitivity to turbidity), virtually none of the indicators we were asked to consider encompassed/addressed all these concerns. Clearly the nutrient concentration & load indicators link natural and human activities to ecosystem responses most directly. However, the specific nutrient indicators we were asked to evaluate, by being regional in scope, often were incapable of identifying and quantifying specific problems on the individual ecosystem level. Temporal limitations in measurements, including measurements made at sub-optimal, irrelevant, or inappropriate times, proved to be serious constraints on both the meaningfulness and utility of indicators. Some indicators, including potentially harmful red tides in the Gulf of Mexico, are not easily linked to nutrients or other indicators of human activity. These biotic indicators are not likely to be effective in identifying drivers of nutrient-related problems plaguing our estuarine or coastal waters, most notably eutrophication, hypoxia or anoxia. Simpler, more direct indicators of eutrophication, including chlorophyll *a*, photosynthetic production, and oxygen consumption (respiration) rates are likely to be more meaningful indicators of the effects of nutrient enrichment than red tides or for that matter crab reproductive capabilities.

Hypoxia is a potentially powerful indicator of estuarine and coastal degradation that *may* be potentially linked to excessive nutrient loading. While the Gulf of Mexico Mississippi plume region as the most highly visible example of this phenomenon, I may not be the best example of linkage to excessive nutrient loading. There are numerous examples of smaller estuarine ecosystems and embayments, including portions of Long Island Sound, Chesapeake Bay, the Neuse River Estuary, Mobile Bay, and inland waters (e.g. Lake Erie), where the spatio-temporal linkage between excessive nutrient loading, enhanced productivity and enhanced bottom water oxygen consumption (hypoxia) are more directly linked. As an indicator, hypoxia should probably be examined on an ecosystem-by-ecosystem level. One shoe doesn't fit all with regard to this hydrological/hydrodynamic-, nutrient- and organic matter-sensitive indicator, which is sensitive to the interactive effects of these 3 variables. In and of itself, Gulf of Mexico hypoxia dynamics may not be translatable to any other regions or ecosystems.

Pawley: Overall, I believe that most of the indicators presented are extremely important; however, with that said, the duplication of indicators from the National Coastal Condition Report II combined with the lack of adequate indicators for the same subjects in freshwater systems, is a major problem. For example there are benthic indicators, sediment contaminant indicators, fish contaminant indicators developed for coastal areas but not for freshwater systems. Some of these indicators were planned for incorporation in this report; but there were impediments to developing them in time. It would be good to address this issue more fully at the meeting; so that the group can collectively understand these issues and possibly provide some support or guidance.

***Coastal Condition Indicators:*** Coastal indicators are better represented in the report than those of freshwater ecosystems; however, indicators based on population and community variables such as fish, birds and marine mammals should be added to this section. SAV and Harmful Algal Blooms should be expanded to include examples from other regions.

**Freshwater Water Quality Condition:** In Fresh Surface water, indicators for Nitrogen, Phosphorus, Water Clarity, and Chlorophyll *a* should be added for large lake systems. Nitrogen, Phosphorus in Large and wadeable streams (Material planned but not provided).

**Habitat Extent Indicators:** In the habitat indicators section, there was a significant focus on wetland habitats but other aquatic habitats were not addressed. If it is not addressed elsewhere, the extent of *riparian habitat* should be included, and the *extent of natural corridors for migratory fish in streams* should also be incorporated as a habitat extent indicator. In California and nationally, there are GIS coverages of dams and barriers that could be used to accomplish this goal.

**Restoration Indicators:** Specifically indexes which track restoration over time of wetlands and stream corridors would help encourage and highlight these practices and efforts to build more accountability through better tracking systems.

**Sensitive Biota (Plants, Inverts, Birds, Fish) Index:** Indices that highlight population changes in the species for which we have recovery plans or are on state threatened lists, would help us better track the improvements made under the Endangered Species Act. In some cases other species might be used as surrogates if populations are extremely rare and difficult to monitor.

**General comment on presentation format.** In addition, because the indicators are extracted from various sources, the graphical presentation and even the rating of these indicators varies across the report. There should be a concerted effort to develop and present the indicators in a consistent fashion using similar regional designations.

Urquhart: The indicators based on EPA 620/R-03/001 are solid and very relevant, as are the ones from the National Wetlands Inventory. For a different reason the one on water under contaminated sites also is very important. All others have some questionable features. Of those, the one related to discharges from large rivers is the most important and probably should be included in ROE. My summary follows

INDICATOR	PRIMARY SOURCE	RELEVANCE	INCLUDE?
Lake and Stream Acidity	EPA 620/R-03/001	HIGH	FOR SURE
Nitrate, Phosphorus, and Pesticides in Streams in Agricultural Watersheds	USGS	MARGINAL	NO
Nitrogen and Phosphorus Discharges from Large Rivers	USGS	IMPORTANT	PROBABLY
Nitrates and Pesticides in Groundwater in Agricultural Watersheds	USGS	MODERATE	POSSIBLY
Wetland Extent, Change, and Sources of Change	NWI	HIGH	FOR SURE
Coastal Habitat Index	NWI & EPA 620/R-03/002	MODERATE	PROBABLY
Coastal Condition Index	EPA 620/R-03/002	HIGH	FOR SURE
Coastal Water Quality Index	EPA 620/R-03/002	HIGH	FOR SURE
Coastal Sediment Quality Index	EPA 620/R-03/002	HIGH	FOR SURE

Coastal Benthic Index	EPA 620/R-03/002	HIGH	FOR SURE
Extent of Hypoxia in Gulf of Mexico and Long Island Sound	CENR/STATES	MODERATE	PROBABLY
Harmful Algal Bloom Outbreaks	HABSOS/STATES	MODERATE	PROBABLY NOT
Chesapeake Bay Blue Crabs: Mature Females – Spawning Stock Abundance	CHESAPEAKE BAY COMMISSION	MODEST	NO
Submerged Aquatic Vegetation in Chesapeake Bay	REPORT TO EPA CHESAPEAKE BAY PROGRAM	MODEST	PROBABLY NOT
Population Served by Community Water Systems that Meet All Standards	EPA	SUBSTANTIAL	YES
Coastal Fish Tissue Contaminants Index	EPA 620/R-03/001	HIGH	FOR SURE
Contaminated Groundwater Under Control on Contaminated Lands	EPA	HIGH	YES

- 2) Are there any additional *national-level* indicators that make an important contribution to answering one of the ROE questions in your topic area, but were not proposed for ROE06, that you would recommend? (Proposed indicators should meet the ROE indicator definition and criteria, be national in scale, be of a quality that likely would pass this type of peer review, and have data that are readily available. For any new indicators proposed, provide justification for their inclusion and list references or citations for the associated underlying data sources.)

As you consider this question, ***please read Attachment 5***, which provides the list of water and other indicators presented in ROE03 that EPA does not intend to carry forward to ROE06, along with EPA's rationale for withdrawing them. If you disagree with EPA's rationale and feel any of these indicators should be included in ROE06, please so indicate in your response to this question, along with your rationale for why they should be included. Note: The full text and graphics for the ROE03 indicators can be viewed on-line at: <http://www.epa.gov/indicators/roe/html/tsd/tsdWater.htm>

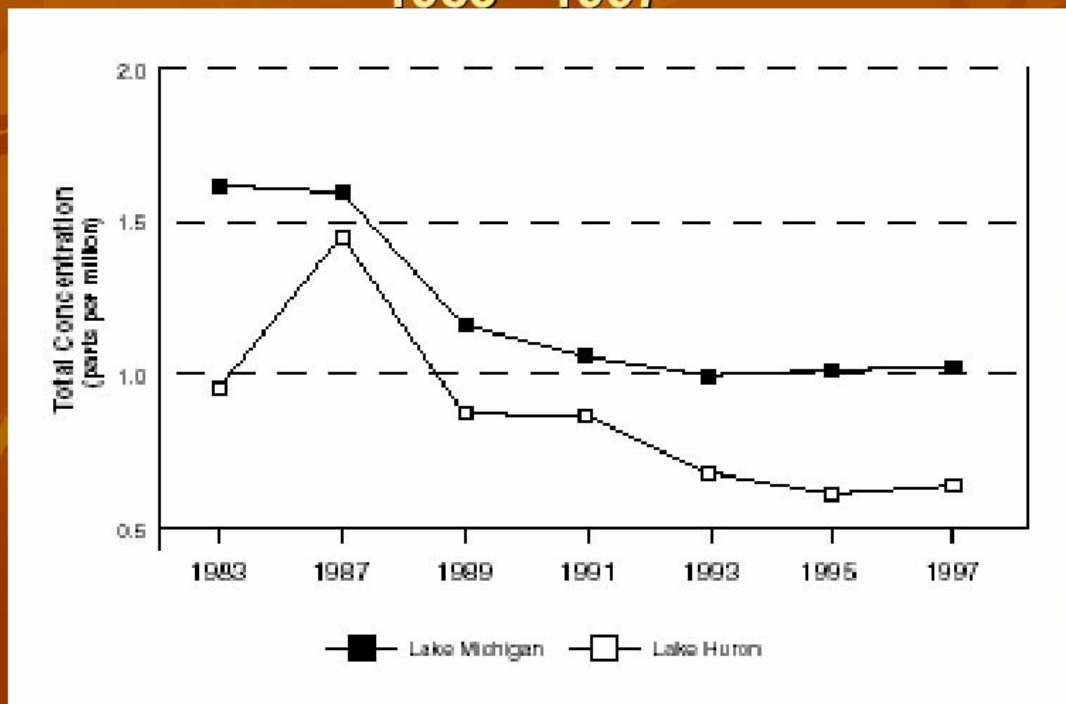
Creal: Of the indicators that EPA is withdrawing, I find that there are 3 that merit some consideration for inclusion somehow. These are:

1. **Contaminants in Fresh Water Fish.** The document indicates that this indicator is being replaced by a new indicator, however, there is nothing drafted yet. This indicator should be reworked to represent the levels of PCBs and mercury both spatially and temporally for the freshwater systems. PCBs and mercury are by far the two primary bioaccumulative contaminants that cause the majority of problems in the United States freshwater systems. The example presented above, and the example below are both possible ways to rework this data for the Great Lakes. There is also a substantial database available for mercury in fish from inland lakes, and their trends over time.

Michigan has a trend monitoring program in place for a set of indicator inland lakes with data from 1990 to present. Minnesota and Wisconsin have similar monitoring programs. These data portray a lake rich area of the country.

## Environmental Measures — Ecological Indicators

### PCB Concentration in Chinook Salmon Fillet Samples from Lakes Michigan and Huron 1983 - 1997



37

Although I could not access Minnesota's database directly or find a summary of their data, I did find the following excerpt from a report of theirs, indicating that their database is present and fairly robust:

**Long-term Trends** — The MPCA has an objective of a 10% reduction in mercury levels in fish from 2000 levels by 2010, and it will use FCMP data to determine whether this goal has been reached. The FCMP has documented the long-term reduction of PCBs in fish, and sampling has been repeated in selected lakes to assess long-term trends in fish tissue concentrations of mercury. As of 2002, enough data had been gathered on 184 lakes so scientists could compare past to present mercury contamination in fish. Among those lakes, mercury levels in standard length fish have decreased in about twice as many lakes as they have increased. In the lakes for which there are three or more years of data, the median mercury concentration in fish decreased 11% from 1990 to 2000. The MPCA needs more data to evaluate and substantiate this initial finding.

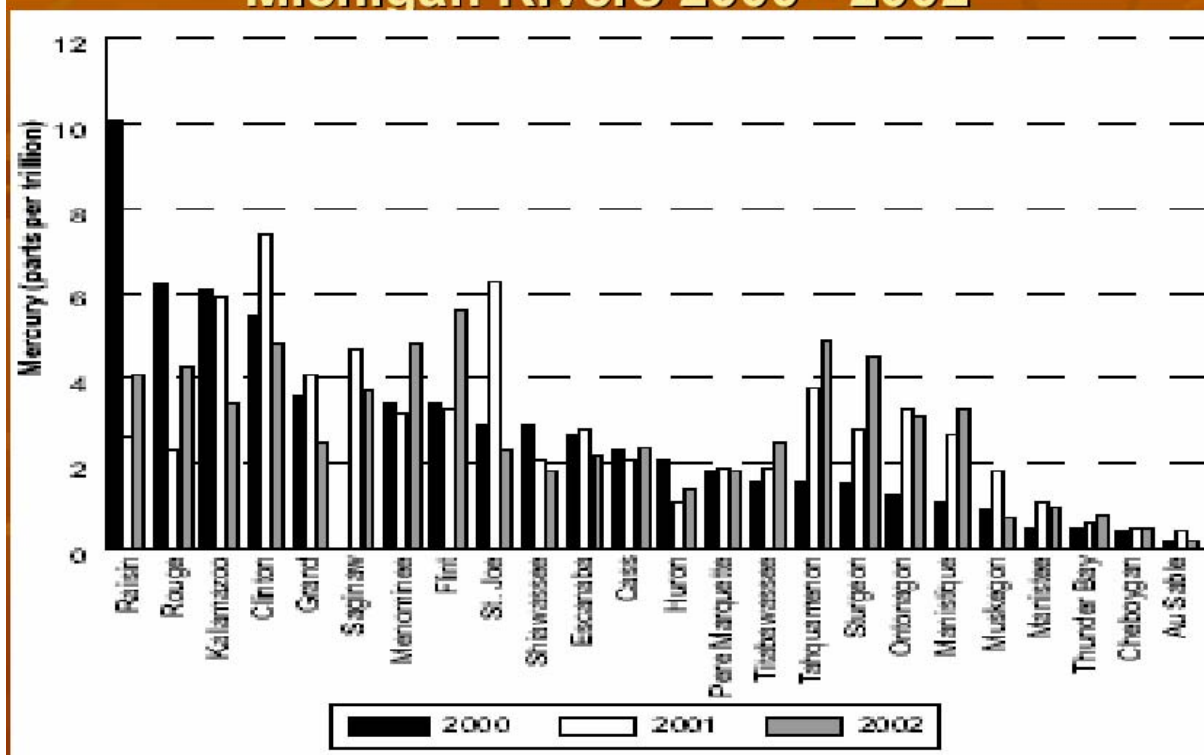
2. **Macroinvertebrate IBI.** The document indicates that this indicator has been replaced by a new macroinvertebrate indicator based on data from an EPA national

statistical survey of wadeable streams. This would be excellent, except that there is no indicator drafted yet, and no indication that one is forthcoming. This indicator should be included nationally somehow, using the state data as available, even allowing for some differences in how results are gathered and reported. This has been successfully addressed in this document for other indicators where the analytical method, sampling process and sampling location have all changed over time, and done successfully. This is very important in this process, as this will happen repeatedly as indicators are used, and the focus of the indicators changes. Recognition and development of this sort of process will enable a broad dataset to be used to support indicators.

3. **Chemical Contamination in Streams and Groundwater.** This indicator should be reworked to include an analyses of important contaminants, such as low level mercury and PCB analyses in streams. There is a very large database available from the federal and state government agencies that follow the promulgated EPA methods for low level mercury for example. This low level mercury method was developed and promulgated in the late 1990s, and is now allowing a nationwide dataset to be developed for mercury in water. This dataset could be used to present an indication of what mercury concentrations are in surface waters across the nation. Many states are now developing such datasets, and EPA could encourage the continuation of this with its control over a large portion of the nation's monitoring monies. Below is an example of how this indicator was presented in a state indicator report. There is a more limited dataset available for PCB analyses, primarily because of the method constraints required to analyze for low level PCBs in water. EPA should develop and promulgate a method for low level PCBs in water similar to what was done for mercury, which would allow for the development of such a national dataset.

## Environmental Measures – Physical/Chemical Indicators

### Average Total Mercury Concentrations in Michigan Rivers 2000 - 2002



63

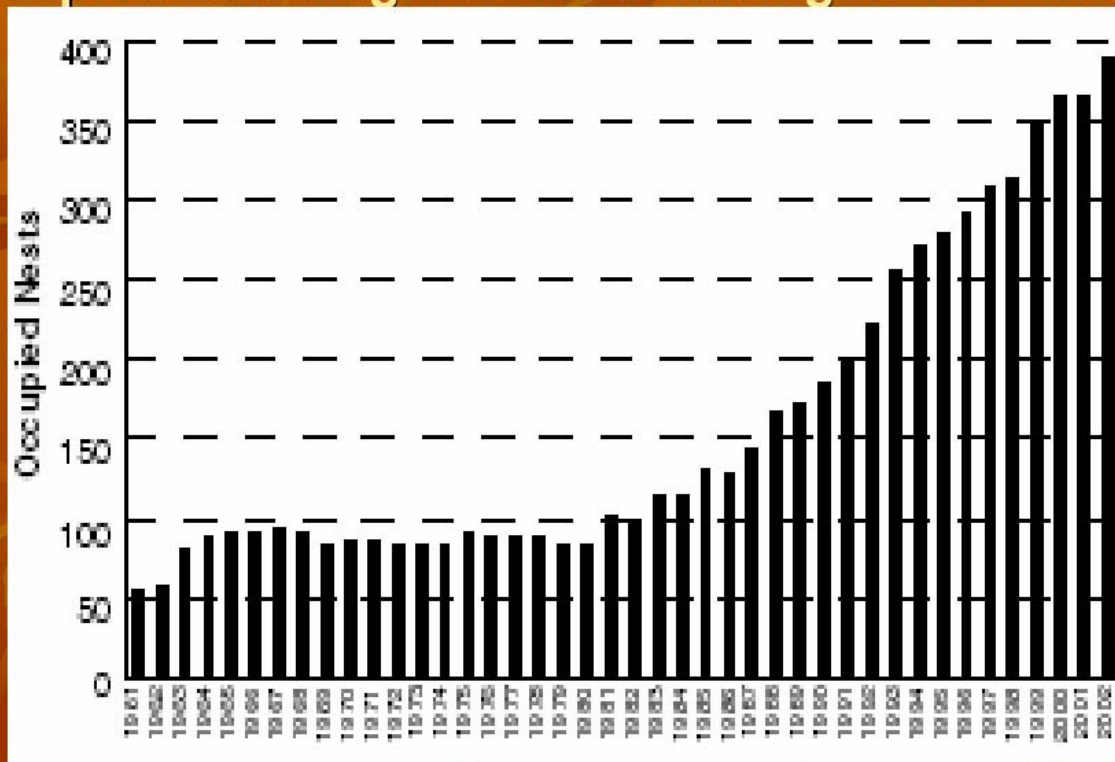
#### Additional Indicators

I would also suggest consideration of fifteen additional indicators. These are indicators that are closely associated with the health of our waters.

1) One of the effects of consumption of contaminated fish is manifested in the fish eating bird populations, including bald eagles. Three indicators should be considered here: the occupied bald eagle nests, reproductive success, and relative contaminant levels in bald eagles – these all serve to indicate the condition of our waters from this respect. Occupied eagle nests and reproductive success indicators would be effects indicators, while the contaminants levels would be exposure indicators. Below are three presentations of datasets available in the Great Lakes. Some of these datasets are available on a fairly wide basis for the nation.

# Environmental Measures – Ecological Indicators

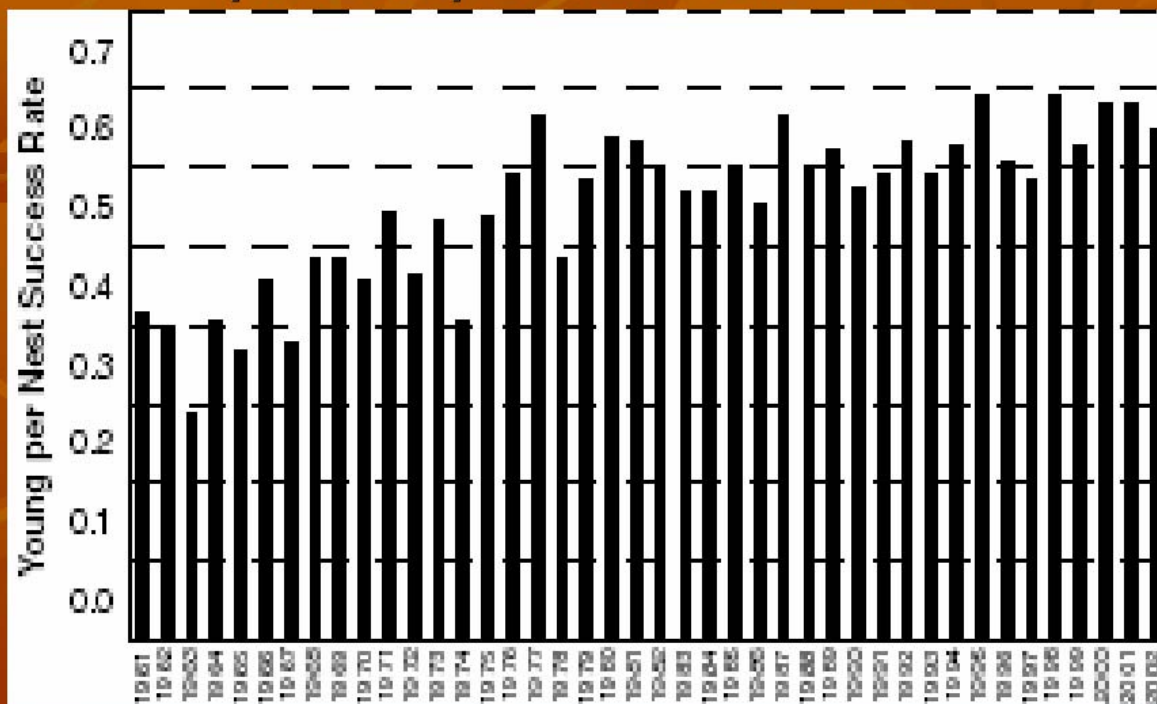
## Occupied Bald Eagle Nests in Michigan 1961- 2002



25

Environmental Measures – Ecological Indicators

## Success Rate for Bald Eagle Young Fledged per Occupied Nest 1961 - 2002



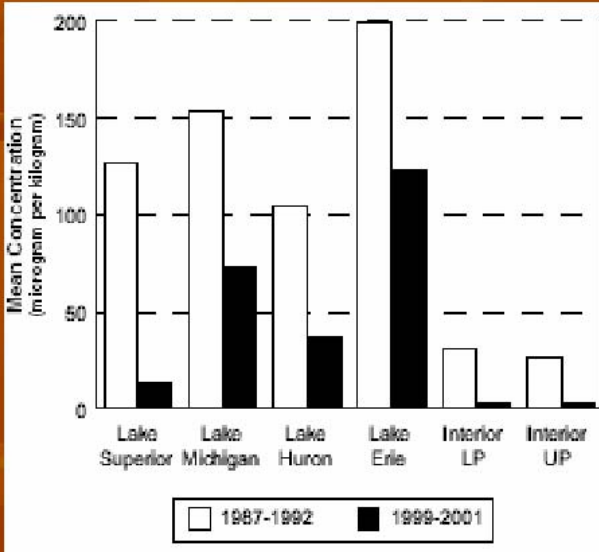
26



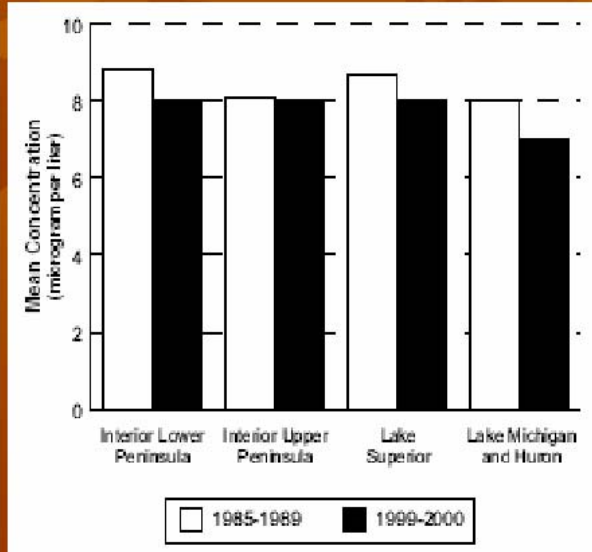
## Environmental Measures – Ecological Indicators

### Polychlorinated Biphenyls (PCBs)

### Concentrations in Nestling Bald Eagle Blood and Mercury Levels in Nestling Bald Eagle Feathers



**Mean PCBs Concentrations in Blood decreased between 1987 – 1992 and 1999 - 2001**

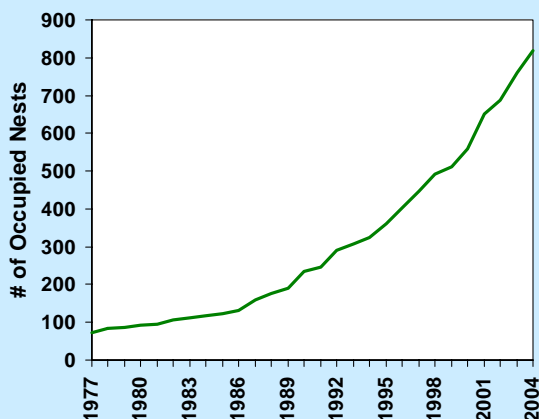


**Mean Mercury Levels in Feathers decreased between 1985 – 1989 and 1999 - 2000**

27

Here is one that is available from the Chesapeake Bay monitoring:

### Bald Eagle Populations on the Rebound!



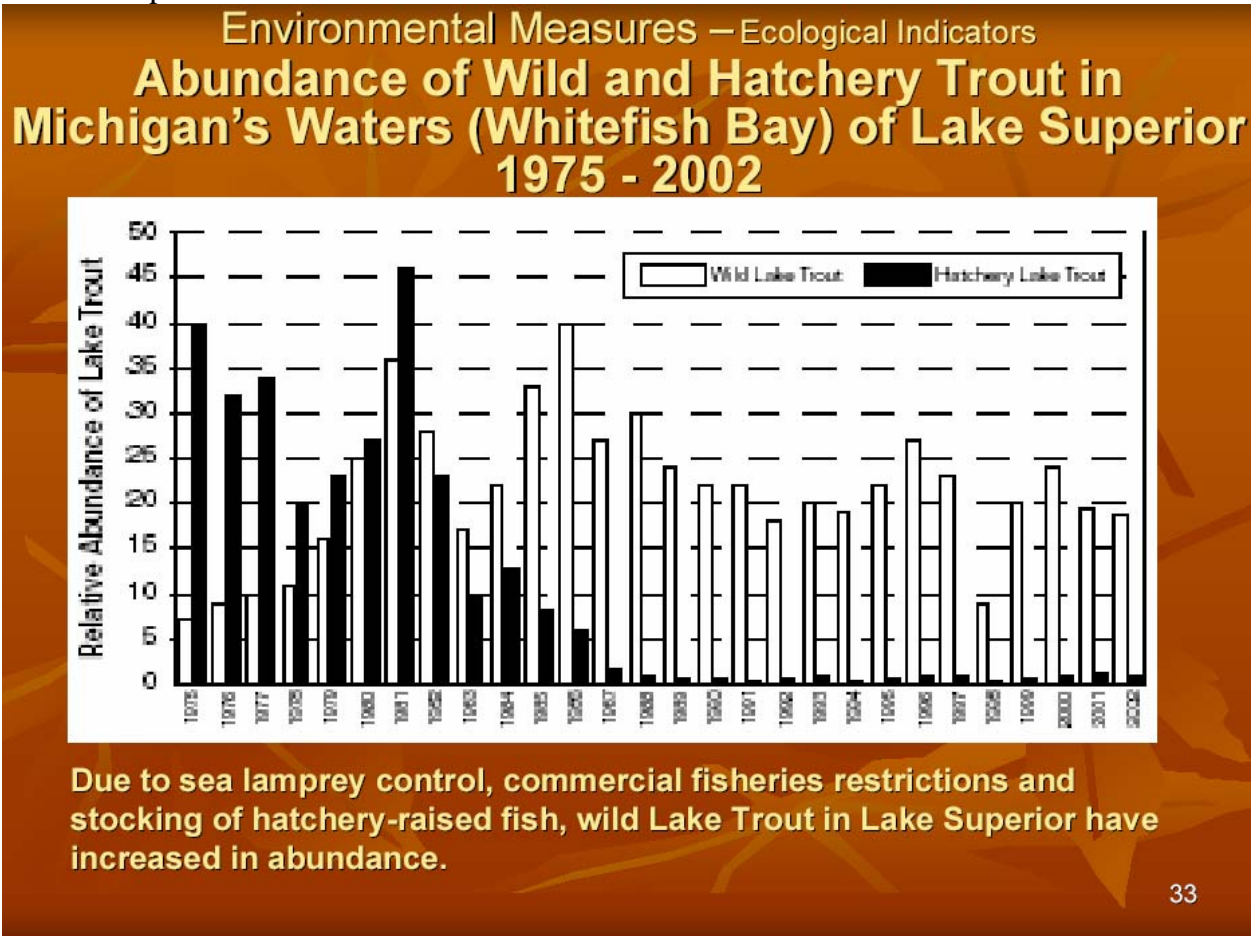
**Actions to control chemical contaminants have led to improved conditions in the Bay.**

**Bald eagles are no longer endangered due to the ban on the pesticide DDT and subsequent habitat improvements.**



CBP 7/6/05

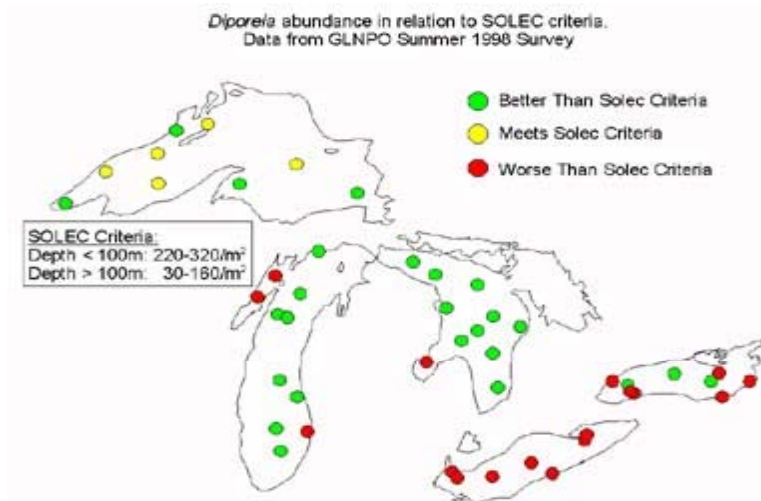
2) The Great Lakes also have several “indicators” established by the International Joint Commission, which is composed of representatives from the United States and Canada. One of these indicators is having a natural reproducing Lake Trout population present. Lake trout populations have declined substantially over the past hundred years due to overfishing, toxicants, pollution in general, and especially the introduction of an exotic species, the sea lamprey. This indicator would be an effect indicator and reflects the health of at least one Great Lake, and could be expanded to include all Great Lakes as data becomes available.



Another is the abundance of *Diporeia* in the Great Lakes sediments as an indicator of biotic health of the lake. This would also be an effects indicator. The data presented below are from an EPA survey in 1998.

# Benthic Community Health

## Abundance of Diporeia 1998



**Goal:** Diporeia populations meet SOLEC Criteria for abundance.

**Status:** Goal is met except in Lake Erie and Lake Ontario, Green Bay and Saginaw Bay.

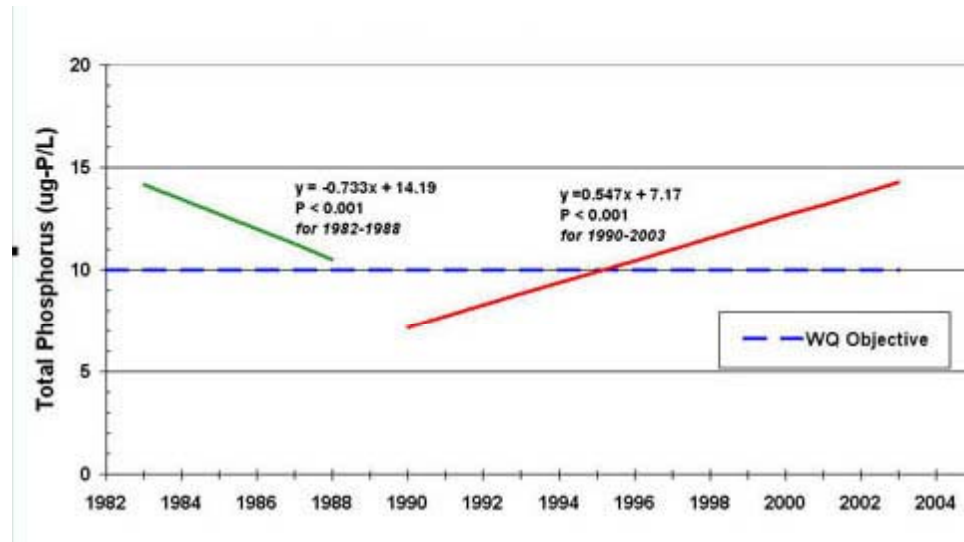
**Trends:** Significant decreases seen in Diporeia populations in Lake Michigan.

**Issues:** Diporeia are a key component of the Lakes' food-chain.

A third Great Lakes indicator that may be tied with hypoxia is the trend of phosphorus concentrations in Lake Erie. This trend is important because phosphorus is the limiting nutrient in Lake Erie, and increased phosphorus causes increased phytoplankton biomass, which in turn causes increased hypoxia. This could be set as either a pressure or ambient indicator and would be coupled with the proposed Lake Erie hypoxia indicator, as suggested in the comments for the Hypoxia indicator (238R). Below is a chart of the trends in Lake Erie phosphorus (produced by EPA Great Lakes National Program Office).

# Lake Erie Phosphorus

## Central Lake Erie Spring Total Phosphorus Trends



**Goal:** Total Phosphorus in Lake Erie Central Basin should be at or below IJC Water Quality Objective of 10 ug/l

**Status:** Goals is not being met.

**Trends:** Total phosphorus levels have been increasing since the early 1990s

**Issues:** Increasing phosphorus loads and disruptions of food web by aquatic nuisance species may cause future problems in Lake Erie's Central Basin.

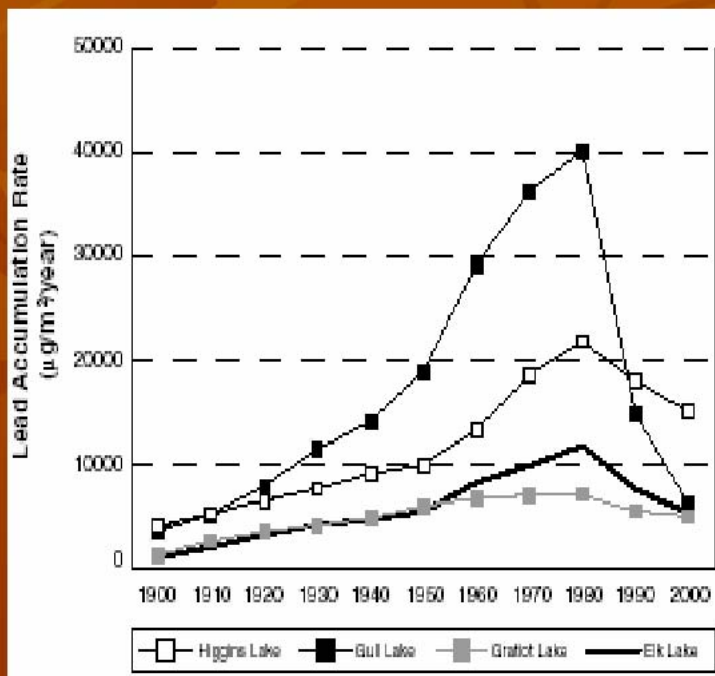
3) The accumulation of sediments on lake bottoms provides an invaluable tool to monitor temporal trends for a variety of contaminants, and to measure the success of some relatively recent programs. There exists a dataset in Michigan, the Great Lakes, and for some additional lakes around the nation, that details these temporal trends. For example, the success of the removal of lead from a variety of sources such as gasoline and paint can be seen in the decline of the lead accumulation rate of lead in Michigan lakes as shown below. This indicator would be a pressure or ambient indicator. Other contaminants may reflect the local land uses in the watershed, or the addition of various substances, like copper, for weed control, as seen in the copper chart below.

## Inland Lake Sediments

### Lead Accumulation Rates in Four Lakes 1900 - 2000

Measuring trends in the accumulation of toxic chemicals in sediments are useful to assess the overall quality of aquatic systems.

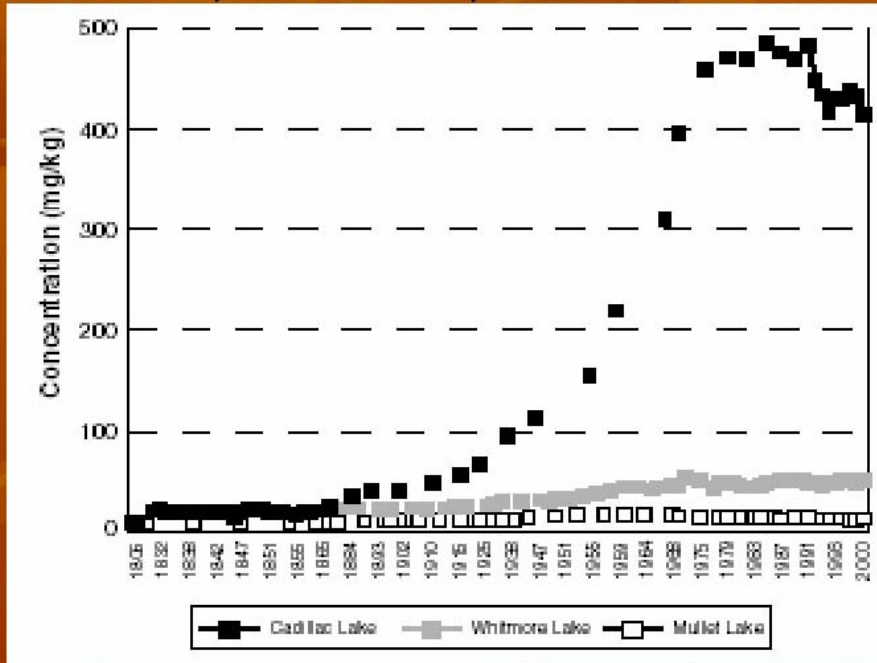
As material is deposited on the bottom of lakes over time, the sediments serve as a chemical recorder of temporal trends of toxic contaminants.





# Environmental Measures — Physical/Chemical Indicators

## Concentrations of Copper in Sediments from Cadillac, Whitmore, and Mullet Lakes 1805 - 2001



The steep increase in copper in Cadillac Lake is thought to be due the frequent use of copper sulfate to remove algae from the lake .

65

An additional set of sediment core information is available to support the trends in mercury. This would be part of the suite of indicators focused on mercury and PCB, and would be an ambient indicator.

Further evidence for declines in midcontinental North America comes from the analysis of an ice core from the Fremont Glacier in the Wind River Range, Wyoming (Figure 15; Schuster *et al.* 2002). From this historical trend reconstruction, one can see the approximate magnitude of the pre-industrial (or natural) background level of mercury cycling through the environment, and spikes in mercury caused by events such as volcanoes. The ice core record shows a distinct decline since the 1980s. Evidence of declines in atmospheric deposition of mercury in New England has been found from bog cores in Maine (Norton *et al.* 1997) and multiple lake cores in Vermont and New Hampshire (Kamman and Engstrom 2002).

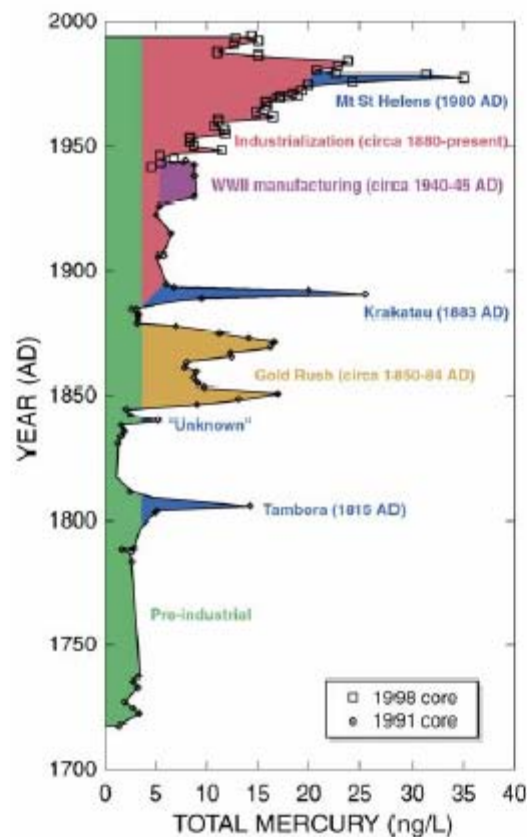
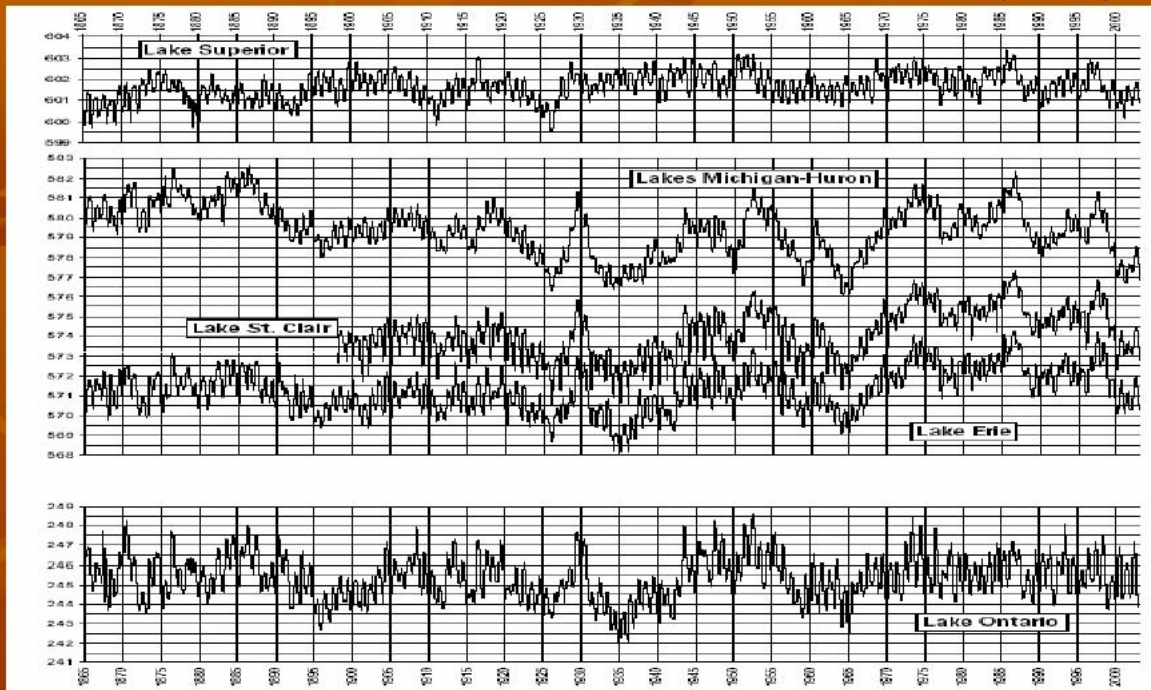


Figure 15 Mercury Accumulation Record in the Fremont Glacier, Wyoming

4) An important indicator similar to the rate of loss of wetlands is the water levels present in various water bodies. An extensive dataset on the Great Lakes water levels exists, with about 140 years of data now available. These types of physical datasets may be important as we strive to understand if, when and how climate changes are occurring. This may be best as a pressure indicator.

## Environmental Measures – Physical/Chemical Indicators

### Great Lakes Water Levels 1865 – 2002 (in feet)

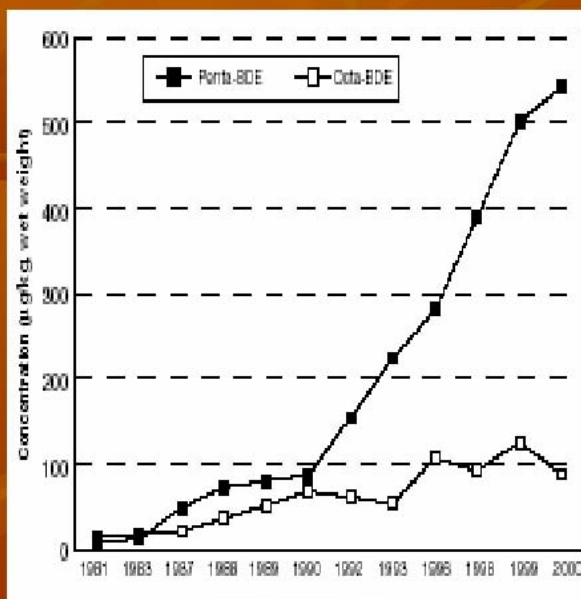


**Low levels occurred in the mid-1920s, mid-1930s, and early 1960s. High levels occurred in 1929 - 1930, 1952, 1973 - 1974, 1985 - 1986, and 1997 - 1998.** 68

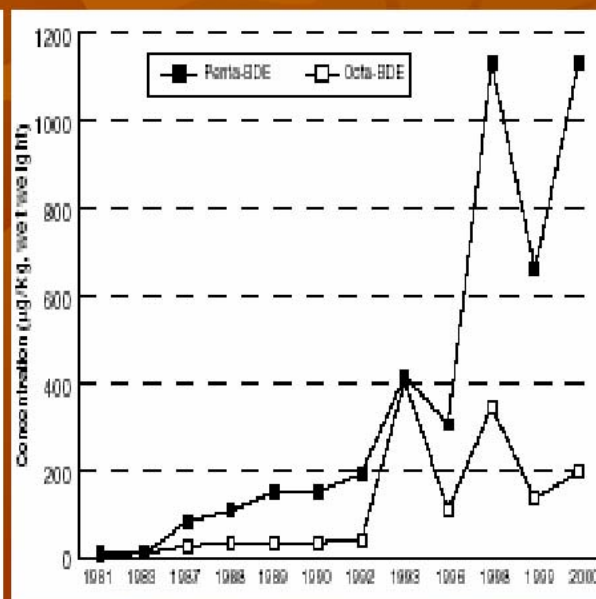
5) Environmental agencies are constantly being asked what is the next contaminant of concern that will be emerging. We all acknowledge that this is an extremely difficult question to answer. However, consideration should be given to presenting available datasets that indicate increasing trends in contaminants in our environment, such as the dataset presented below for brominated diphenyl ethers. This would be an exposure indicator.



## Emergent Contaminants of Concern - Brominated Diphenyl Ethers BDE Concentrations in Herring Gull Eggs 1981 - 2000



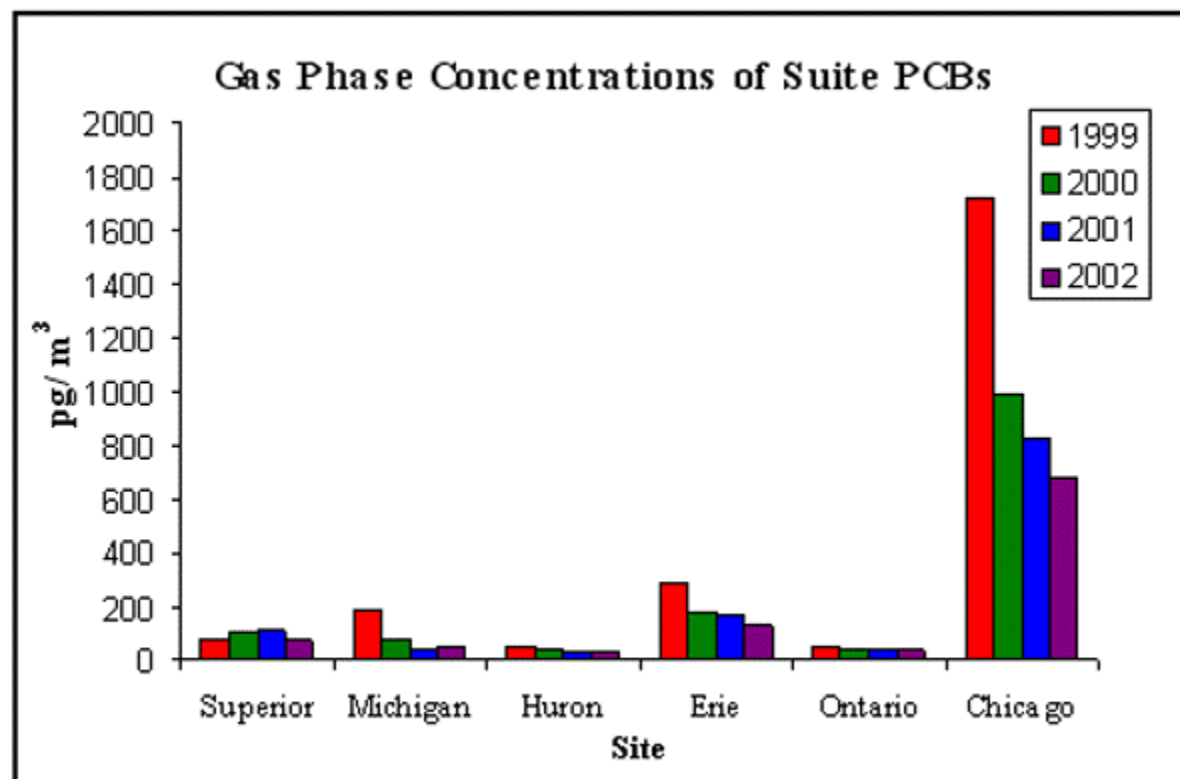
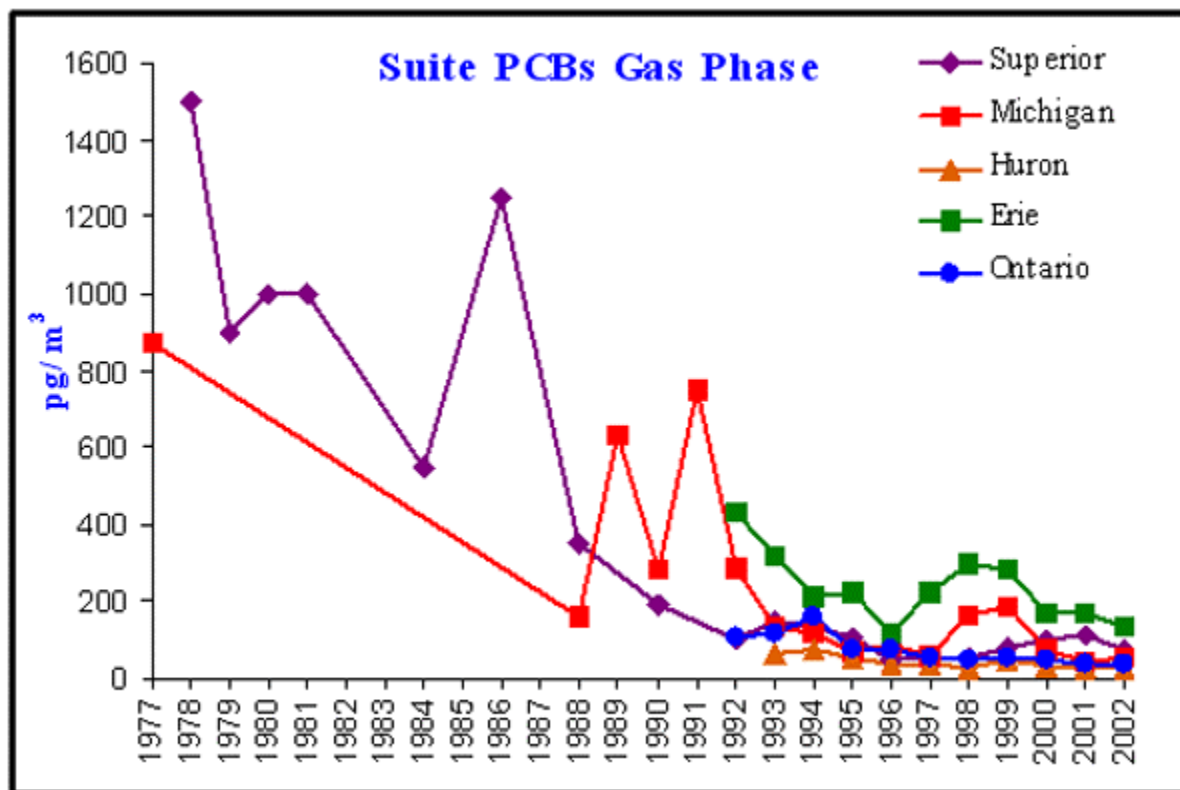
Channel-Shelter Island,  
Saginaw Bay, and Lake Huron



Gull Island, Lake Michigan

11

- 6) In addition, the atmospheric load of several contaminants is now the controlling factor in some water quality issues, like PCBs and mercury. This is especially true for large freshwater bodies like the Great Lakes. I would suggest adding a pressure indicator for the rate of air deposition on the Great Lakes for some of these contaminants, like PCBs. This information is available, as shown below. The details of this indicator are available at <http://www.epa.gov/grtlakes/glindicators/air/airb.html>.



There may also be information to serve as a pressure indicator for mercury, and construct a more complete picture of where the mercury situation is headed, or where attention needs to be focused. The following graphs are from the recently published draft Mercury TMDL for the state of Minnesota:

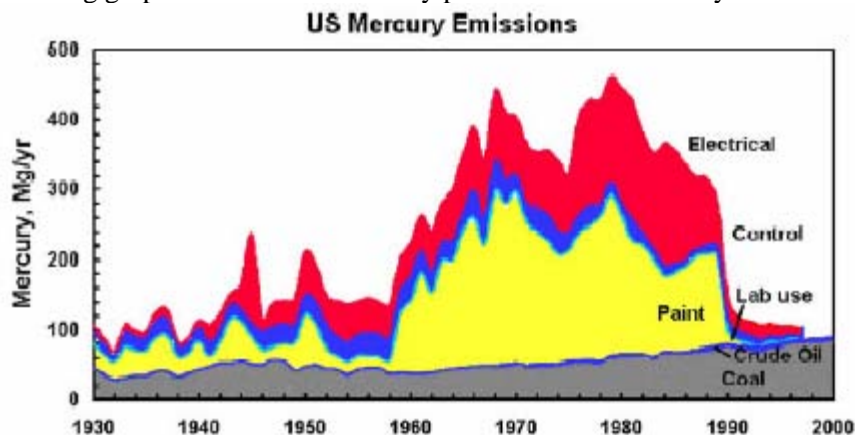


Figure 12 United States Mercury Emissions by Category

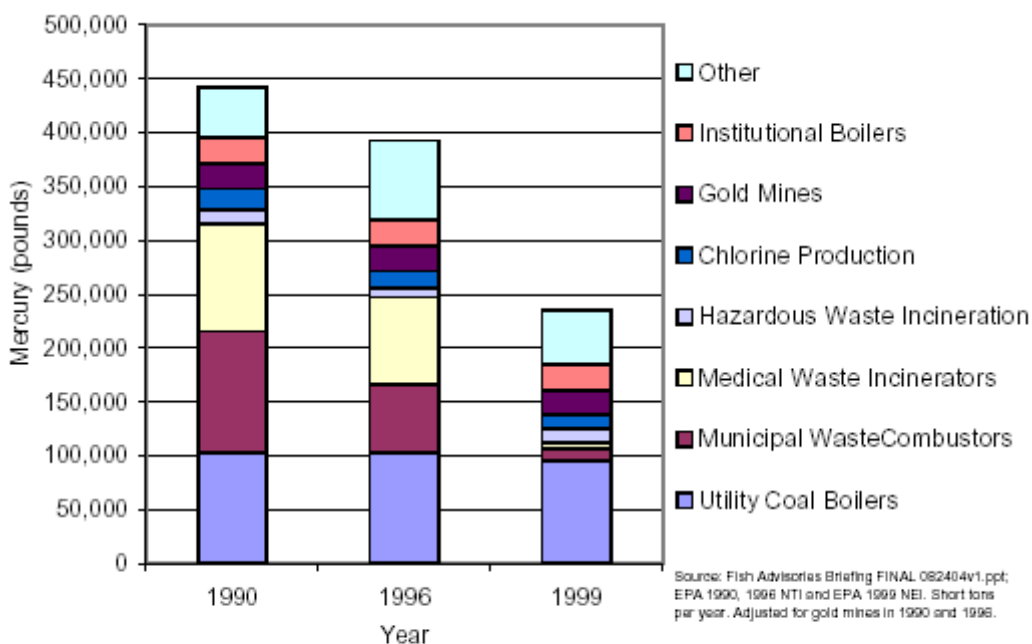


Figure 14 USEPA's anthropogenic mercury emissions in U.S.

- 7) There is a trophic state index for the Great Lakes with a goal for each Great Lake established. This is suggested as an exposure indicator. This is summarized in a short write-up with all five Great Lakes presented graphically (It wouldn't copy here for me). An example presentation of the detail is given below for Lake Superior. Details are available at <http://www.epa.gov/glnpo/glindicators/water/trophicb.html>.

# Chapter 2 Trophic State

## Great Lakes Trophic State 2001



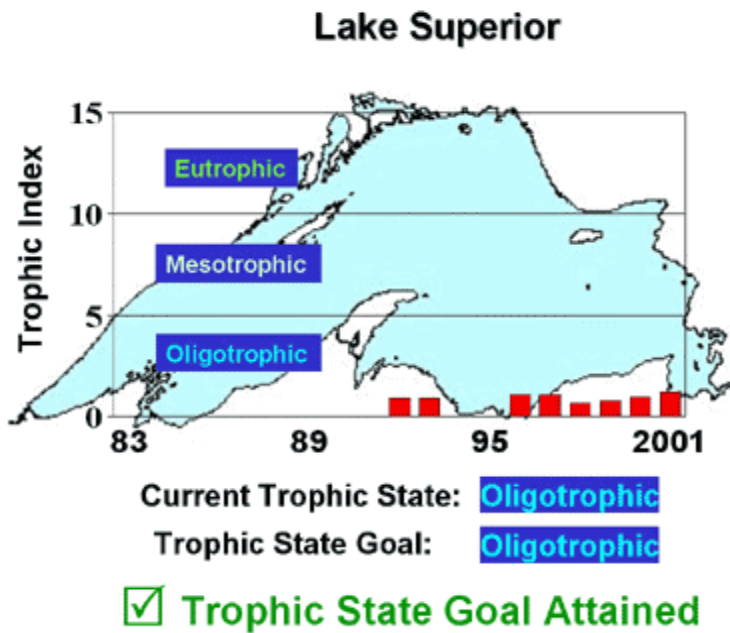
**Goal:** [Oligotrophic](#) state in Lakes Superior, Michigan, Huron and Eastern Basin of Lake Erie; oligomesotrophic in Lake Ontario and in Central Basin of Lake Erie; mesotrophic in Western Basin of Lake Erie.

**Status:** Goals are met.

**Trends:** The [depletion of oxygen](#) in the Central Basin of Lake Erie, in addition to potentially increasing [phosphorus](#) concentrations, indicate potential problems.

**Issues:** Increasing phosphorus loads and disruptions of food web by aquatic nuisance species may cause future problems in Lake Erie's Central

Basin.



- 8) I also recommend that EPA focus some of the indicator effort on developing indicators for known common problems. An example of this would be PCBs and mercury. These two pollutants have caused widespread contamination across the United States. For these pollutants, there should be indicators in all four categories – pressures, ambient, exposure and effects. I believe these indicators presently exist for these pollutants, and datasets are available for them. As an example, for the Great Lakes there is trend data available for all of the following indicators:

**Pressures**

Atmospheric deposition of PCB and mercury  
US mercury emissions

**Ambient**

PCB and mercury concentrations in water  
Sediment core (and glacial) mercury concentrations

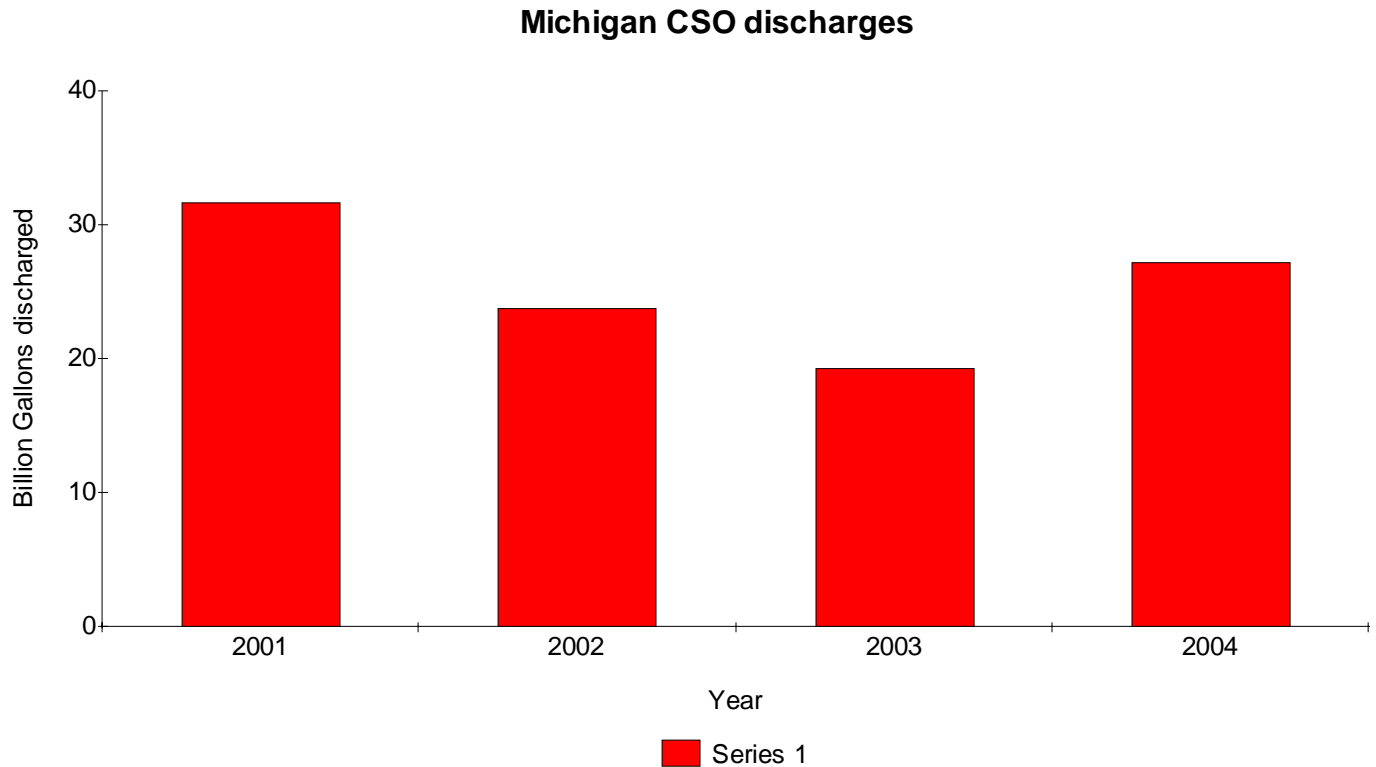
**Exposures**

Fish concentrations of mercury and PCB  
Eagle concentrations of mercury and PCB

**Effects**

Number of eagle nests  
Eagle reproductive success

- 9) I realize the category Recreation In and On the Water has no indicators proposed at this time. I would suggest that EPA has developed a Combined Sewer Overflow (CSO) Discharge database that could be used as a pressure indicator here. This would require some data mining on EPA's part, as I believe that most of this data is in state databases. However, Michigan has a dataset that could be used for a Great Lakes indicator, with total gallons of CSO discharge summarized for each year since 2001 in a report to the state legislature. Below is a graphical presentation of the information:



Over time, as CSO Long Term Control Plans are implemented, this indicator should show the progress made in eliminating the discharge of untreated or partially sewage to the waters of the United States.

Paerl:

1. Chlorophyll *a* (and other diagnostic photopigments) concentrations
2. Primary production (rate measurements and in bioassays)
3. Water transparency (which is linked to SAV habitability, but also phytoplankton community composition)
4. Oxygen consumption (respiration rates) in sediments and water column
5. Phytoplankton community composition (in relation to changing nutrient inputs and ratios)

Pawley: ***Many of the “dropped indicators should be reevaluated.*** There are numerous indicators that were dropped in this report that I think should be re-evaluated for inclusion. In many cases, the indicators are suggested to be of a regional nature; however, I can think of many more examples for these indicators developed in other regions, in addition to the region mentioned in the list. The ROE has relied heavily on Atlantic coast lists of indicators but a more national search should be accomplished for many of the concepts suggested. So, the question is rather, can and how might these indicators be expanded to incorporate more regions, in the process ensuring more consistent techniques for national use. Examples include: Lake Trophic State Index, Fish IBI, Macroinvertebrate IBI (Freshwater streams).

*Additional national level indicators need to be developed* and I have suggested numerous ideas under the Question 1 above. I am suggesting these ideas with the understanding that most are not ready to be brought into this report but a process should be in place so they might be developed in the near future. EPA should work closely with the Heinz Center and other entities in this regard

Urquhart: **NONE**

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## **Comments for Group 2 Indicators**

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## Attachment 4: Comment Sheet for the Group 2 Indicator

Topic Area: **Land**

Indicator Name: **Contaminated Groundwater Under Control on Contaminated Lands**

- 1) To what extent do you think the indicator meets the following indicator definition:

*An “indicator” is a numerical value derived from actual measurements of a pressure, ambient condition, exposure, or human health or ecological condition over a specified geographic domain, whose trends over time represent or draw attention to underlying trends in the condition of the environment.*

1	2	3	4
Doesn't meet the definition	Only partly meets the definition	Largely meets the definition	Fully meets the definition

Please explain:

Creal: (3) EPA indicates in the discussion for this indicator that this indicator is a measure of pressure on ground water resources (T2Q1), rather than a measure of ambient ground water quality or human health exposure (T2Q2). However, in the table of indicators, this indicator is put under the ambient category. This indicator seems most appropriate as a pressure indicator, given the population of sites used and endpoints chosen.

Paerl: (3) This indicator reflects key pressures (nutrient loads, sedimentation) that impacts ambient conditions. Good linkage to habitat condition, but no clear linkage to human health effects.

Pawley: (3) To its credit, the indicator for contaminated sites shows trends in contaminated groundwater sites under control; however, it is overly simplistic. NPL's are only a subset of sites and the sites are not necessarily equal in terms of their area of impact and effects. For example, a site under control might be very small in its area compared to another site that is not “under control”.

Urquhart: (4) This indicator provides direct summaries of a potentially important impactor of grounds water quality.

- 2) To what extent do you think the indicator meets each of the following indicator criteria:

- a) The indicator makes an important contribution to answering a question for the ROE. (In this context, “important” means that the indicator answers a substantial portion of and/or a critical part of the question.)

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (4)  
Paerl: (3)  
Pawley: (2)  
Urquhart: (4)

- b) The indicator is objective. It is developed and presented in an accurate, clear, complete, and unbiased manner.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (2)  
Paerl: (4)  
Pawley: (3)  
Urquhart: (4)

- c) The underlying data are characterized by sound collection methodologies, data management systems that protect its integrity, and quality assurance procedures.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (2)  
Paerl: (3)  
Pawley: (3)  
Urquhart: (3)

- d) Data are available to describe changes or trends, and the latest available data are timely.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (4)  
Paerl: (3)  
Pawley: (4)  
Urquhart: (3)

- e) The data are comparable across time and space, and representative<sup>17</sup> of the target population. Trends depicted in this indicator accurately represent the underlying trends in the target population.

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<sup>17</sup> An indicator seeks to describe trends in an overall target "population" (e.g., land area, type of surface water, type of emissions, U.S. population), yet data often can only be sampled from a subset of this population. The validity of

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (4)  
Paerl: (2/3)  
Pawley: (3)  
Urquhart: (4)

- f) The indicator is transparent and reproducible. The specific data used and the specific assumptions, analytic methods, and statistical procedures employed are clearly stated.

1	2	3	4
Doesn't meet this criterion at all	Only partly meets this criterion	Largely meets this criterion	Fully meets this criterion

Creal: (2)  
Paerl: (3)  
Pawley: (4)  
Urquhart: (4)

Please explain:

Creal: This is a good indicator that is useful in representing this situation. This indicator presents important information on a legacy issue that our nation is facing. However, there is a reliance on several choices to develop this indicator that will influence the outcome. First, this is more on the lines of a programmatic indicator by definition of the population of sites used. However, it does seem appropriate as a pressure indicator. Second, this indicator relies primarily on the judgment of the project manager to ascertain if the indicator attribute is achieved. This is probably suitable for this situation as a pressure indicator. Third, the endpoints used in the process are variable by site and location (state), and it is not clear if state Water Quality Standards, state groundwater quality standards, or other endpoints are used in this process. If state standards are used, this introduces another variable into this indicator, which is not necessarily a detriment, but should be explained as to how differences between states, or sites, are handled. I would propose that this issue be expanded and explained, and the number of indicators that rely on State WQS and reports (like 305b) should be expanded in this overall process. Fourth, this indicator integrates multiple contaminants in groundwater over multiple sites and locations. This is a difficult indicator to accomplish without allowing some of the choices to be made that will introduce bias and uncertainty into the indicator.

Paerl: [no answer provided]

Pawley: The NPL does not include all of the CERCLIS sites, so should be expanded to include(possibly through a sub-indicator) hazardous waste sites that are of lesser priority. Also

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the trends described by the indicator will depend on the degree to which the sampled population is representative of the target population.

as noted above, (if possible) the area of influence might be incorporated to weight sites by severity.

Urquhart: The EPA response to T4Q1 correctly notes that this indicator is a population measure for which target population and statistical inference are not appropriate.

- 3) Do you have any suggestions for more effective graphic presentation of the data?  
If yes, please describe.

Creal: Yes. The graphs are very effective. One minor suggestion would be to include the percentage in the NPL graph, as was done in the RCRA graph.

Paerl: [no answer provided]

Pawley: Include more complete descriptions of data in figure legends.

Urquhart: Graphics are generally fine, but note that the acronym “GM” in the title and legend is undefined in the text and near the figure. Is it intended to denote Groundwater Migration?

- 4) Please provide any additional comments, suggestions, or concerns regarding the indicator that you have not already noted in Questions 1 through 3. In particular, note any limitations to the indicator that you have not already described in your responses to the preceding questions.

Creal: The population of contaminated sites represented by these two programs is commendable, but it needs to be recognized that there are additional sites of contamination that are handled by various other programs, especially at the state level. Also, the statement is made that “contaminant data are collected using standard sampling and analytical methods that result in data of known quality”. I have seen several investigations that have had to use fairly unique sampling and analytical methods, because of the complex nature of the Superfund or RCRA site being dealt with. I would expect that this is the case more often at these complex sites, than is found at contaminated sites handled by states. Also, statements relating to “well defined and widely accepted” ecological risk assessment practices, and “well established tools for assessing potential effects on ecological receptors” do not provide any detail or specifics as to what methods are actually used in the process. This may be an appropriate location to discuss the use of differing endpoints, standards, sampling and analytical techniques, and how these are addressed in the development of the certification by a responsible official that the criteria necessary to designate a site under control have been met.

Paerl: [no answer provided]

Pawley: [no answer provided]

Urquhart: None

- 5) Overall, this indicator:

Creal:   X   Should be included in ROE06 TD.

Paerl:   **X**   Should be included in ROE06 TD with the modifications identified above.

Pawley:   **X**   Should be included in ROE06 TD with the modifications identified above.

Urquhart:   **XXX**   Should be included in ROE06 TD with the modifications identified above.